COMPUTERS
AND
AUTOMATION

CYBERNETICS • ROBOTS • AUTOMATIC CONTROL

Division of Labor in Scientific Digital Computer Service Facilities
. . . L. N. Caplan

Cam Profile Design With The Univac 120
. . . Louis D. Grey

Supplementing Electronic Equipment With a Modern Communications System
. . . Monroe M. Koontz

Use of a Computer for Certain Operations of Classification
. . . Andrew D. Booth

Robots and Automata: A Short History — Bibliography
. . . J. T. Culbertson

New Products and Ideas

Western Joint Computer Conference, Los Angeles, February 26-28, 1957 — Program, Titles, and Abstracts

COMPUTERS AND AUTOMATION

CYBERNETICS • ROBOTS • AUTOMATIC CONTROL

Vol. 6, No. 4 April, 1957

ESTABLISHED SEPTEMBER, 1951

ARTICLES AND PAPERS

Division of Labor in Scientific Digital Computer Service Facilities	... L. N. Caplan	6
Cam Profile Design With the Univac 120	... Louis D. Grey	10
Supplementing Electronic Equipment With a Modern Communications System	... Monroe M. Koontz	12
Use of a Computer for Certain Operations of Classification	... Andrew D. Booth	18
Robots and Automata: A Short History — Bibliography (Part 2)	... James T. Culbertson	20

NEW PRODUCTS AND IDEAS 8

REFERENCE INFORMATION

Western Joint Computer Conference, Los Angeles, February 26-28, 1957, Program, Titles, and Abstracts 25

Association for Computing Machinery, Los Angeles Chapter, Meeting, Los Angeles, March 1, 1957, "New Computers: A Report from the Manufacturers", Program 30

Symposium on Systems for Information Retrieval, Western Reserve University School of Library Science, Cleveland, Ohio, April 15-17, 1957, Program 31

FORUM

On Glossaries and Malapropisms ... Alston S. Householder 33

The Editor's Notes 6

Index of Notices 6

Advertising Index 46

Publisher: Berkeley Enterprises, Inc.

815 Washington Street, Newtonville 60, Mass. – Decatur 2-5453 or 2-3928

Advertising Representatives:

New York – Milton L. Kaye, 601 Madison Ave., New York 22, N.Y., Plaza 5-4680

San Francisco – W.A.Babcock, 605 Market St., San Francisco 5, Calif., Yukon 2-3954

Los Angeles – Wentworth F. Green, 439 So. Western Ave., Los Angeles 5, Calif., Dunkirk 7-8135

Elsewhere – the Publisher

Subscription rates: in the United States – one year $5.50, two years $10.50; in Canada – one year $6.00, two years $11.50; elsewhere – one year $6.50, two years $12.50

Entered as second class matter at the Post Office, New York, N.Y.

THE EDITOR'S NOTES

NEW PRODUCTS AND IDEAS

We take pleasure in putting into this issue of "Computers and Automation" brief accounts of two important new developments in the computer field, neither yet completed. They show again how unlimited this field is. One is an account of Project STRETCH, in which the U.S. Atomic Energy Commission and International Business Machines Corp. are engaged. This machine will gulp a million program instructions a second. The other is an account of the Datamatic 1000, which is due to be complete in the autumn. It will sort or merge 5000 items of 12 decimal digits per second. Both set new marks. We tried very hard to get a third frontier computer story, which has been described at recent computer meetings; we wrote letters and wired, but received no response to any of our requests.

To your editor, the computer field is still extraordinary. He started work upon graduating from college in 1930 in the actuarial department of a life insurance company as an actuarial clerk. For four years, his equipment consisted of large sheets of ruled paper for entering figures, tables of actuarial functions and formulas, and desk calculating machines, where to shift from one figure column to the next, you turned a handle. In the 13 years since 1944, the change has been tremendous. To mathematics with wings have been added arithmetic and calculation with wings.

It is a satisfaction to think of the important new products and ideas in the computer field which without any doubt will come into existence in the next 50 to 100 years:

- Machines that will recognize
- Machines that will play chess or other games at least as well as nine tenths of human players
- Machines that will handle language as intelligently as sixty percent of human beings
- Machines that will teach, supplementing and aiding the work of teachers in school
- Machines that will treat over ninety percent of cases of mental illness, and diagnose nearly a hundred percent of all cases of illness
- Machines that will calculate alternative solutions to social and economic problems, and alternative plans for the production of a whole society

And more besides. There is no theoretical barrier to any of these machines.

WHO'S WHO IN THE COMPUTER FIELD, 1956-57

This extra number of "Computers and Automation", 212 pages long, went to press on March 11. It contains 199 pages of entries, with about 61 entries per page, each showing name, address, and some information for about 12,000 computer people.

Please look at your entry in the directory, and please tell us of any revision needed. We expect to print revisions in early issues of "Computers and Automation".

THE COMPUTER DIRECTORY AND BUYERS' GUIDE, 1957

This regular number of "Computers and Automation", the June issue, will contain as Part 1, a "Roster of Organizations in the Computer Field", and as Part 2, "Buyers' Guide to the Computer Field: Products and Services for Sale or Rent". For roster entry forms, see page 43 of the March issue.

The closing date for information to be published in the directory will be about April 30.

*———————— * ————————*

NEW PRODUCTS AND IDEAS

		Page
1.	The Datamatic 1000 Computer	8
2.	The Project STRETCH Computer (IBM)	8
3.	Programming With Soap (Symbolic Optimum Assembly Programming)	9

*———————— * ————————*

INDEX OF NOTICES

For Information on:	See Page:
Advertising Index	46
Advertising Rates and Specifications	44
Back Copies	37, 40
Bulk Subscription Rates	32
Manuscripts	see Mar. issue
Reader's Inquiry Form	46
Special Issues	see Mar. issue

Address Changes: If your address changes, please send us both your new and your old address (torn off from the wrapper if possible), and allow three weeks for the change.

Microton hardness test typifies quality control measures that leave nothing to chance at Automatic Electric

STANDARDS THAT DETERMINE RELAY QUALITY/

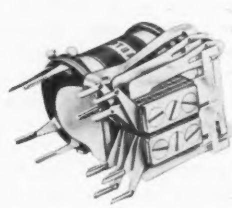
the ideal relay iron

Only soft, pure iron assures proper release, even after millions of operations.

In service, many relays get progressively slower to release, until finally the armature hangs up permanently. Excessively "hard" magnetic relay iron often is to blame. But in all Automatic Electric relays, the magnetic iron is so soft and pure that it saturates quickly, yet the flux dies out instantly. Even after millions of operations!

This improved relay iron is made and rolled to our own exacting specifications. Chemical analysis then makes certain that no magnetic capabilities have been lost. Annealing is rigidly controlled, and grain size and temper carefully checked. Elongation, hardness, permeability, and density tests further safeguard this pampered material. Result: not the *ideal* relay iron, but *the most nearly perfect iron available.*

This is no isolated example. Exhaustive tests prove that all our raw material is equally fine. It's one of the many reasons why Automatic Electric relays enjoy far longer life.



Series SQPC Relay for printed circuitry applications. *Write today for Bulletin RH-9. Automatic Electric Sales Corporation, Chicago 7.* In Canada: *Automatic Electric Sales (Canada) Ltd., Toronto.* Offices in principal cities.

AUTOMATIC ELECTRIC

Originators of the dial telephone • Pioneers in automatic control

GENERAL SYSTEM

DIVISION OF LABOR IN SCIENTIFIC DIGITAL COMPUTER SERVICE FACILITIES

L.N. Caplan
463 Irving St.
Dayton 9,Ohio

The past five years have seen a "Topsy-like" growth of digital computer scientific service facilities in American industry. Since this growth has been so rapid, labor division has been done on an expediency basis rather than by planned organizational procedure. The result is an overlapping of technical and semi-technical skills in particular jobs within computer service organizations. With the shortage of highly skilled personnel that exists at the present time, efficient use of personnel is a serious problem.

Not much has been written about this particular aspect of computer facility organization. The following theory of organization is a possible guide toward a solution of this problem.

An endeavor will be made to delineate the types of work to be done within the organization, to estimate skills required for the work, and to assign specific job classifications. Thus, the company thinking of adding a digital computer facility will get at least a framework idea of what is required in the way of organization. Existing facilities may gain an idea or so for making better use of the personnel they now possess.

Problems brought to the computing facility can usually be classified into three types. The division of labor will be made upon the basis of solution of these three types — that is, the people called upon to solve problems of a certain type will be placed in a specific job classification. It should be noted that solution of any problem involves cooperation and exchange of information between job classifications. The work should be arranged so that employees of one job classification learn from the employees of another. There is nothing so conducive to labor turnover as assigning a specific function, such as machine coding only, to members of the organization.

Job Classification for Problems of Type I

In all mathematical and engineering problems a good portion of the mathematics involved is simple algebraic and transcendental equation solution. Therefore, the solution of these equations is the first type problem to be considered. If a range of variables is desired in combination with a large number of values for the coefficients of the equation, hand calculation (although possible) is now prohibitive time wise; and the solutions of these equations are machine computation problems.

The skills required for the solution of this type of problem are: A working knowledge of algebra and trigonometry, coding knowledge of the machine being used, and a clever knack for machine logic. In solving these problems machine errors, errors in logic, and other simple numerical mistakes are invariably encountered. Therefore, in addition to the skills listed above, the person solving the problem must be able to diagnose trouble in the case of incorrect answers or failure of the problem in the machine. This calls for an exacting knowledge of the machine itself, as well as an analytic mind. The two latter features are no small part of the job.

Let us call the job classification for solving this type of problem, "Programmer".

Since even the latest computing machines can only add, subtract, multiply, and divide, if the equations given to the programmer contain functions of a variable, such as exponential of X, root of X, sin X, etc., the programmer must have available methods of using add, subtract, divide, and multiply to compute these functions. These methods are commonly known in the trade as sub-routines. We shall leave the designing of the sub-routines to the second job classification.

Job Classification for Problems of Type II

Under problems of Type II consider:

Solutions of differential-integral equations with variable coefficients that have no known or simple closed form solution.

Systems of algebraic or differential equations with variable coefficients.

Functions as $\log x, \sin x, x^{1/n}, e^x$.

These problems all have one thing in common when done on a computer. An approximating series or iterative procedure must be used. The solution of these problems requires all of the skills embodied in solving problems of Type I, plus a working knowledge of numerical analysis techniques. Consider evaluating an integral. Will Simpson's Rule for solution furnish accurate enough answers? Perhaps it is necessary to start the solution with one method and later change to another. Not only is there a difference of accuracy in these methods, but there may be a large amount of machine time difference. Since machine time for the larger machines is estimated at costing between 4 and 12 dollars per minute, the method will make quite a difference in the cost of solving large problems. The better the problem solver is acquainted with the machine itself, the better he is able to determine what numerical techniques to use with respect to accuracy of solution, economy of time, and trouble shooting procedure in case of difficulties arising in machine solution.

Type II problem solvers are "Numerical Analysts". As mentioned previously, the analyst must supply machine subroutines for evaluating mathematical functions to the Programmer. The Programmer is then able to use these routines in solving equations involving these functions. Once the numerical analysis has been done on a problem (which means it has been reduced to algebraic equations) the problem may be turned over to the programmer.

Job Classification for Problems of Type III

Type III problems deal with the design of mathematical models of physical systems, such as chemical processes, rockets, jet and airframe performance, and electronic servomechanisms. The mathematical model must be suitable for machine computation. Such a system may save building pilot models, since the experimentation is done mathematically by varying design parameters numerically in the machine. In some instances, control over the actual processes is desired through the use of a stored program digital computer*.

*See Fortune, April 21, 1956. The article entitled "Automation" furnishes information about this type of problem.

Type III problems differ from Types I and II in that in the latter problems the equations were furnished by the person desiring solution. It is assumed that the equations arose from problems that originated in Research and Development. In this type problem the solver must help formulate the equations. His decisions are based upon his knowledge of what the machine can do. One might think that the physical system determines the formulation of the mathematical model, but this is not true. Consider a problem where maximization of a quantity is desired. It is the problem solver's decision as to whether linear programming or Lagrange multiplication method is most appropriate. The design of physical systems is usually done by an engineering group. Such a group might include a chemical, electrical, mechanical engineer, and perhaps a physicist. If the problem is to be solved via mathematical machine models, the group will have to include a person from the computer section. This person can be called a "Computer Applications Consultant". In order to design a mathematical model for a physical system, the problem solver must be able to understand and communicate with the engineers working on the project. Therefore, a broad engineering background is desired. In addition to having all the knowledge required to solve problems of Type I and II, the consultant must have an excellent knowledge of mathematical techniques, especially of recent developments. He should know which portions of the problem are best solved by analog machines rather than digital computers. Personality will play a large part in his job, as the consultant must be a team worker and be able to consult harmoniously with the engineering group.

After the model has been formed by the consultant, he turns this model over to the numerical analyst. The analyst having reformulated the model into algebraic equations turns the problem over to the programmers for coding. After the problem has been completely solved, the consultant must help interpret the results for the engineering group.

There is one other position that must be included in the organizational setup. This is a "Machine Techniques Specialist" to prepare formats for machine input and output, design input and output methods, keep abreast of new techniques that may be used on the machine, and teach the how and what required to use the machine for problem solution. The job calls for a person who has grown up with computing machinery in the past five years rather than a mathematician. Often the company supplying the machine will furnish a machine techniques specialist for the first few months of installation.

(cont'd on page 36)

NEW PRODUCTS AND IDEAS

THE DATAMATIC 1000 COMPUTER

Henry W. Schrimpf
The Datamatic Corporation
Newton Highlands, Mass.

The first one of the Datamatic 1000 computers made by the Datamatic Corporation, formed 1955 and jointly owned by Minneapolis-Honeywell Regulator Co. and Raytheon Mfg. Co., is more than 85% complete. It is scheduled to be delivered to the purchaser, Michigan Hospital Service, in the autumn. A summary of its main features follows (Note: "dd" means "decimal digits" and "dds" means "decimal digits per second"):

1. Input Convertor: receives source data in punch card form / reads twice, compares, edits, arranges, and delivers to a magnetic file unit / processes 900 fully punched cards per minute / can accept the presence or absence of any one of 12 punches in any one of 80 columns of each punch card, so that each column of a punch card can convey any one of 2^{12} pieces of information / converts into binary codes in fours and sixes, giving a machine word of 52 binary digits, which can be a set of 12 dd, or 11 dd and sign, or 8 alphanumeric characters, or any one of many other choices with great flexibility.

2. Main Memory of Magnetic Tape: tape, 3 inches wide / 31 parallel recording channels / reels, 2700 feet long / maximum capacity of each reel, 37.2 million dd / reading and recording speed, 60,000 dds / up to 100 magnetic tape file units can be directly connected in a single system / up to 10 tapes can be scanned simultaneously / maximum searching rate, 600,000 dds.

3. Intermediate Memory of Input Register Buffers: magnetic cores / total capacity, 1488 dd / receives data at rate of 60,000 dds / delivers data to high-speed memory at 420,000 dds.

4. High-speed Memory of Magnetic Cores / 24,000 dd capacity / access in parallel / access time for a machine word of 12 dd, 10 microseconds.

5. Operations in the Central Processor: additions, 4000 per second / multiplications, 1000 per second / speed of sorting machine words of 12 dd, 5000 per second, or 60,000 dds / speed of merging machine words, 5000 per second, or 60,000 dds / thus for business and commercial problems the machine can utilize fully the speed of the magnetic tapes.

6. Intermediate Memory of Output Register Buffers: magnetic cores / total capacity, 1488 dd / receive data at 420,000 dds / record on magnetic tape at 60,000 dds.

7. Output Converter: reads data from magnetic tape at 60,000 dds / delivers 80 column punch cards at 100 per minute / prints either 150 or 900 lines per minute, of 120 characters each.

8. Checking, etc. Completely checked internally by a built-in checking system / has an extremely versatile system of orders.

* ——————————————— *

THE PROJECT STRETCH COMPUTER (IBM)

Neil D. Macdonald
New York, N. Y.

The Los Alamos Scientific Laboratory of the U. S. Atomic Energy Commission contracted in November 1956 with International Business Machines Corp. for a computer 100 to 200 times as fast and as capacious as the most powerful commercial computers of the present day, such as the IBM 704 and 705. The name assigned to the new project was STRETCH.

The Atomic Energy Commission has begun to design reactors and other apparatus so complicated that one hundred billion arithmetical operations may

be required to make one evaluation of a single design. A present-day computer would take six months; the Project Stretch computer is expected to take a day.

Some of the main directions for pushing toward this increase of speed and capacity are: (1) the use of faster components coming out of laboratory work on scientific frontiers; (2) anticipation now of solving certain problems within a few more years; (3) multiplexing equipment to gain concurrent operation, thus avoiding waiting by the central computing unit; and (4) more powerful instructions within the computer to reduce the number of steps in calculation.

Some information about the features that this computer will have is now available.

The Project Stretch computer will have a number of main sections. One is an input-output section to maintain smooth swift communication with the magnetic tape file units. A second section is an intermediate serial computer for editing the flow of input and output data. A third section is a central parallel computer to operate as fast as possible on the assembled calculating work of the problem. The machine word will be 12 to 15 decimal digits long.

The intermediate serial computer will operate in either binary notation or decimal notation, and in either fixed point or floating point arithmetic. It will perform addition in 2 or 3 microseconds, and multiplication in 5 to 15 microseconds. Logical operations that are more comprehensive than are most of those in present day computers will be carried out in 2 microseconds. The speed of the intermediate serial computer will be 5 or 10 times the speed of the IBM 704 or 705.

The central parallel computer will consume a million or more instructions a second, which will be prepared for its consumption by the intermediate serial computer, which in its turn will use statements in mathematical and logical notation. In the central parallel computer, fixed-point addition and subtraction will take place in two tenths of a microsecond. Floating-point addition and subtraction will take place in six tenths of a microsecond. Multiplication will take place in 1.2 microseconds. Transfer over buses will take place in two tenths of a microsecond.

The types of memory and input-output devices will include present-day types such as: ferrite core memory, magnetic tapes, paper tapes, manual keyboards, typewriters, card readers, card punches, and printers. New types will also be included: a magnetic-disk randomly addressable memory capable of holding one million machine words and communicating at the rate of one word every four microseconds; and new magnetic tape units communicating at nearly the same speed. The total memory may perhaps be one hundred million words.

The intermediate serial computer will have a high speed parallel memory of 8192 words of 64 bits each. Its full cycle of operation will be two microseconds and it will read out a word in 8 tenths of a microsecond. The central parallel computer will have a high speed parallel memory of 512 words; its full cycle of operation will be half a microsecond.

The machine will have: automatic checking; a means for localizing and signaling errors; and in several places, automatic correction of errors. Transistors in the machine will perform at a 10 megacycle repetition rate; these are coming out of IBM laboratories right now.

————————————————————

PROGRAMMING WITH SOAP (SYMBOLIC OPTIMUM ASSEMBLY PROGRAMMING)

Lockheed Missiles
Van Nuys, Calif.

Employees don't have to be computer experts to use giant "electronic brains" at the Van Nuys plant of the Lockheed Missile Systems division. The company announced on March 19 that they will have the opportunity to use its IBM 650 computers on a do-it-yourself basis to solve mathematical problems they encounter in their work. To qualify, all an employee has to do is take a 12-hour course in programming on company time. A knowledge of simple algebra is the only prerequisite for the course.

E. K. Fisher, head of the plant's mathematics and computer services department, said the new opportunity is aimed to help employees with mathematical problems too complex to be solved easily with desk computers and slide rules. It will also ease the work load of his professional programmers, who can spend more of their time on highly technical problems. Fisher estimated that an employee can easily program and get in a day the answer to a problem which would take him a week to solve by usual means. Here's the way he will do it: First,
(cont'd on page 37)

CAM PROFILE DESIGN WITH THE UNIVAC 120

Louis D. Grey
Remington Rand - Univac Division
Norwalk, Conn.

A good portion of the work of the Univac Engineering Division at the South Norwalk Laboratory of the Sperry Rand Corporation concerns itself with the design of cams for various input and output devices. These cams are now produced by a well integrated process which consists of mathematical analysis of the cam profile requirements, construction and evaluation of mathematical functions which embody these requirements with the aid of the Univac 120, and the production of a paper tape from the punched card output of the computer for the purpose of guiding an automatic cam cutting machine. This process has resulted in a savings of days over the tedious process of mechanically drawing the cam radii and having the cam cut on a human controlled machine. In this paper we describe the problems encountered in the design of a cam profile and illustrate the uses of the Univac 120 in solving this problem. Accordingly, we begin with a description of the Univac 120.

The Univac 120 is a punched card computer using 90 column Remington-Rand cards and capable of handling alphabetic or numeric data. It consists of an electronic computing unit and a sensing and punching unit operating at a maximum speed of 150 cards per minute. Data is processed according to a plugboard program consisting of 40 triple address steps having the following format:

1. First value (V_1) ...... any input-constant or storage value
2. Process (V_2) .... addition, subtraction, multiplication, division
3. Second value (V_2) ..... any input-constant or storage value
4. Result (R) ..... any intermediate-output storage except one used for V_1 or V_2
5. Plus result branching
6. Minus result branching

Additional steps are obtainable through the use of any or all of the 96 selectors. Special instructions are available for releasing values in storage for punching into the card, sorting cards into two groups, clearing storages, transferring selectors, etc. The basic word length is 10 decimal digits with a 22 decimal digit accumulator. Gate vacuum tube trigger circuits are used with bi-quinary coding. Cold cathode gas tubes are used for storage with a slightly different type of bi-quinary coding. Process time including an automatic inverse-process zero check averages 10 milliseconds for addition and subtraction and 50 milliseconds for multiplication and division. At maximum speed 325 milliseconds of computing time are available. If the computation takes longer, the sensing-punching unit automatically waits until the computation is completed. There are three types of storage, as follows:

A. Intermediate-output storage; 12 units of 10 decimal digits each, including sign; or a total of 120 decimal digits.
B. 108 (even) or 216 (odd) decimal digits of plugboard constants, which may be grouped into values of 10 digits maximum.
C. 120 digits (maximum of 90 or any one card) of card input, which may be grouped into values of 10 digits maximum.
Branching is fully flexible and takes place on a plus or minus result.

USE OF THE UNIVAC 120 IN CAM DESIGN

A cam is a device for imparting motion through another device called a follower which is always in contact with the cam. Motion is achieved by varying the lengths of the radii measured from the center of rotation of the cam. The follower center may be constrained to move along the radius of a cam in which case the motion is said to be radial or along the arc of a circle in which case we speak of non-radial motion. These motions are illustrated in Figures 1 & 2.

The cam profile consists of a series of smooth curves which incorporate the dynamic characteristics of the system and which have identical displacements, velocities and accelerations at the point where any two curves are joined. Well known curves used in the design of cam profiles are the harmonic and cycloidal curves[1]. In general, however, a profile can always be obtained in the form of a series of polynomials each of whose degree is one less than the number of conditions the polynomial must incorporate. Thus suppose that a polynomial in θ is to have given displacement, velocity, acceleration and rate of change of acceleration characteristics at $\theta = 0$ and at $\theta = \beta_1$. We shall suppose the follower center to have radial motion since the results need very little modification for non-radial motion.

Let
$$f\left(\frac{\theta}{\beta_1}\right) = A_0\left(\frac{\theta}{\beta_1}\right)^7 + A_1\left(\frac{\theta}{\beta_1}\right)^6 + A_2\left(\frac{\theta}{\beta_1}\right)^5 + A_3\left(\frac{\theta}{\beta_1}\right)^4 + A_4\left(\frac{\theta}{\beta_1}\right)^3 + A_5\left(\frac{\theta}{\beta_1}\right)^2 + A_6\left(\frac{\theta}{\beta_1}\right) + A_7$$

with $f(0) = c_1 \qquad f''(0) = c_5$

$$f(\beta_1) = c_2 \qquad f''(\beta_1) = c_6$$

$$f'(0) = c_3 \qquad f'''(0) = c_7$$

$$f'(\beta_1) = c_4 \qquad f'''(\beta_1) = c_8$$

Imposing the above conditions leads to a system of eight simultaneous linear equations which are then solved to determine the A's.

These equations are conveniently solved on the Univac 120 by employing a routine(3) based on the method of direct elimination featuring floating point decimal arithmetic and good for matrices up to (15x15). If desired the system of equations can be solved for various sets of constants. For an $\underline{m} \times \underline{m}$ matrix ($m \leq 15$) the total number of cards involved is

$$\tfrac{1}{2}\, m(m + 1) \quad (m + 2n)$$

where $\underline{n}$ is the number of columns of constants that the equations are to be solved for. The computer time necessary to solve these m sets of equations is

$$\frac{\tfrac{1}{2}\, m(m + 1) \quad (m + 2n)}{\text{Average card speed}}$$

The average card speed is dependent upon the elements of the coefficient matrix. Having solved these equations, what is then desired is the evaluation of the resulting polynomial at small intervals, say $\tfrac{1}{4}^{\circ}$. This gives the radii of the cam measured about an axis of rotation through the center of the cam. The polynomial is conveniently evaluated on the Univac 120 by using Horner's algorithm. Thus for

$$f(\theta) = A_0\left(\frac{\theta}{\beta_1}\right)^m + A_1\left(\frac{\theta}{\beta_1}\right)^{m-1} + \cdots + A_m$$

$$f_0 = \frac{A_0}{\beta_1^m}$$

$$f_{y+1} = \theta f_y + A_{y+1}, \quad y = 0, 1, \cdots m-1$$

which requires m additions and m multiplications to get $f(\theta)$. Permanent charts of radii for various angles can be made up if a curve is used frequently. The results are produced in the form of punched cards. Information is then taken off the card and either tabulated on special drawing paper enabling a draftsman to construct a drawing of the cam profile or converted in the form of a paper tape by means of the Remington Rand Card-to-Tape Converter (Model 318). The resulting paper tape output is then fed into an automatic machine tool which cuts a cam having the specified profile. It has been found that cams of high quality can be produced by this process cheaper and faster than had previously been possible.

BIBLIOGRAPHY

1 - "Plate Cam Design", M. Kloomok and R. V. Muffley, "Product Engineering", February 1955, p. 156

2 - "Plate Cam Design", M. Kloomok and R. V. Muffley "Product Engineering", May 1955, p. 155

3 - "Simultaneous Linear Equations and Matrix Inversion (floating decimal method) with Univac 120 punched card computer." Remington Rand, 315 Fourth Avenue, New York, N. Y.

4 - "Using Punched Cards for Automatic Machine", A. H. Stillman, "Product Engineering", June 1955, p. 172

5 - "Polydyne Cam Design", D. A. Stoddart, Machine Design, Vol. 25, January, February, March 1953, pgs. 121-135, 146-154, 149-164.

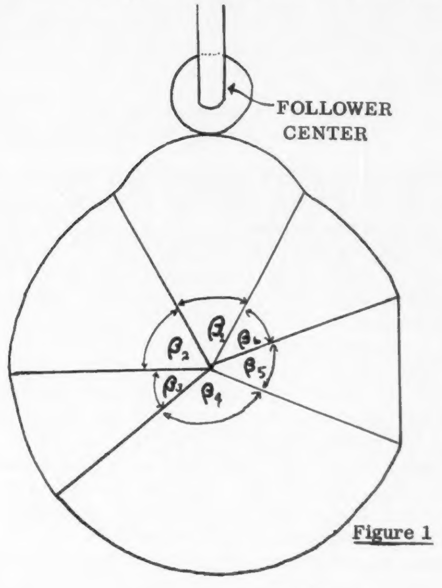


Figure 1

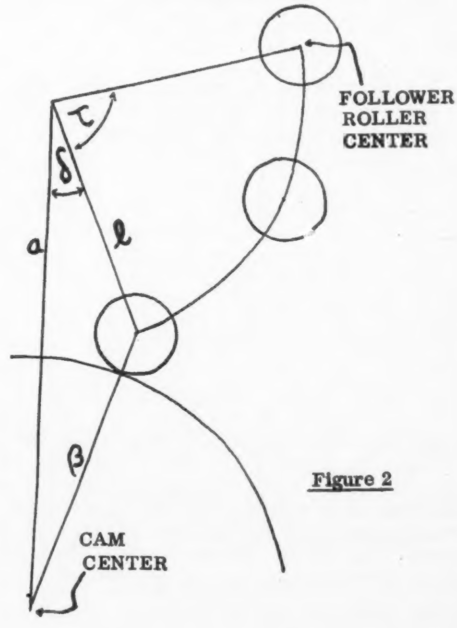


Figure 2

SUPPLEMENTING ELECTRONIC EQUIPMENT WITH A MODERN COMMUNICATIONS SYSTEM

Monroe M. Koontz
Inland Steel Co.
East Chicago, Ind.

(Reprinted by permission from "N. A. C. A. Bulletin", vol. 38, no. 5, Jan. 1957, published by the National Association of Cost Accountants, New York, N.Y.)

The paperwork structure upon which control is based today does not have the physical attributes needed in the transition to an eight hundred billion dollar economy in 1957. Growth of such magnitude means continued decentralization and the accompanying increase in producing units. Each of these must be able to communicate to produce efficiently. Overhead costs will increase geometrically unless the basis—paperwork—of our present control technique is eliminated in large chunks. It is intended, in this article, to relate the new array of office machines with the elements of control, to outline a broad perspective for improving their application, and to suggest changes in emphasis, with regard to office automation, which may be desirable to avoid what might be called a plateau of development, i. e., the limitation of development to a fixed level.

In approaching automation of the office, many experts, busily applying well advanced knowledge in organization management and traditional communication techniques, seem to have overlooked the startling possibility that physical communication facilities now in general use have become so old, technologically speaking, that they must be on the verge of superannuation. Paradoxically—because the line of progress for management, itself, lies in decentralization—the best commercial potential of information processing system may lie in centralization or semi-centralization of communications and data processing. Decentralization of industry puts a strain on over-all control and also places a premium upon control at production locations. This dual need can be served. The executive span of control can be extended considerably by new electronic communications, and the massive ability of centralized electronic systems to boil down routines full of detail can be put to use at all levels.

Limited Means of Control Limits the Economy's Growth Potential

Our thinking should not be burdened by undue emphasis upon tradition either in devices or organization. Current and forthcoming developments will be best adapted to use in terms of their inherent characteristics, and these will impose a need for organizational as well as technical changes. The concept most vital to future planning is the analogy between sensory functions of the individual and what might be possible in the office. In the light of this concept, existing organization concepts will metamorphose extensively. (After the change, the game of organizational chess may be resumed.) There is urgency here. If communications are not given a new structure with a specific goal of tremendous acceleration, economical use of high-speed computers will be hampered and predicted business growth may achieve less than optimum results, and might outrun our ability to control it with paper, with partial stagnation following.

The central problem is that the span of business control is circumscribed substantially by paperwork. Accountants and managers know this well and admit it reluctantly. To reduce the burden of necessary detail by electronic communication and processing will augment the talents of our limited supply of managers and analysts, thus elevating the ceiling over new business growth.

Control as it is known today grew out of the industrial revolution. As technical problems of production were surmounted in the first half of the nineteenth century, the commercial consequences were virile expansion, an extension of division of labor, and continued evolution into departmental allotment of functions. One correct term for this process is

organization, in itself a control tool. Organization in turn encouraged prolific growth, because it lifted the limitations of single management from the application of new technology potentials. By 1900, more than organization itself was needed. The size and expanded logistics of business were getting beyond the personal grasp of the management representative. The medium to supplement—and in turn to constitute—his control was paperwork: reports, charts, and a body of clerks to produce them.

The industrial accountant emerged simultaneously to help decision makers screen vital facts. Paperwork tools, while not exclusive to the industrial accountant, do largely characterize his activity, because they include organization charts, the card of accounts, and the structure of reports to management. The accountant is traditionally oriented to paperwork and, in some situations, new paperwork is the only way to get control. However, it has natural limitations. These are time factors (in terms of both cost and delay) for preparation and transmission, plus a relatively moderate space for filing. Until the last few years, the volume and complexity of business had not progressed sufficiently for these limitations to hurt the operation, but the inexorable establishment of multiple new communication lines—paper vehicles for information—each time a new center of activity was set up, finally began to take its toll.

The Essence of Control Is Immediate Reaction

It is a real dilemma. Communication facility must be improved for continued business growth but, in the natural limitations of paperwork, will not change. The best we can hope for, without a basic divorcement of communications from paper, is to palliate the effects by simplification. However, the American economy of 1975 can be commensurately profitable only if the controllers of business go back to true fundamentals to achieve the controls they are seeking. Basically, these fundamentals, long pushed out of sight, resemble in nature the original control endeavors of an owner of a business. On the current day scene, they take form as electronosensors, or the extension by mechanical and electronic facilities of human sight, hearing, and memory, all interacting instantaneously to relegate details and synthesize action. All of the necessary facilities with which to enact this concept of control are on the market today, and a combination of these with superior potentials can be cheaper, more reliable, and more effective within a given business unit than anything based upon messengers, pneumatic tubes, or medium distance wire transmission, such as telephone and telegraph extensions. These substitute facilities will be considered in greater detail and the use of true electronosensors will be explained. First, however, we need to restore to our consciousness the original model of control appraisal and action as it existed in the sole owner of the one-time typical small enterprise.

The successful, if archaic proprietor, is a data originating, processing and control system within himself. His shop contains most of the elements of the business—fixtures and inventory, a drawer or two containing his purchase and sales slips, and the hidden strongbox or stocking containing the rest of his net worth. His brain serves at once as:

1. The reporting system which corresponds to input in a modern machine installation.
2. The data processing center containing sorting and merging abilities, programs for economical purchasing, payment of bills, and preparation of tax returns.
3. The reporting system which corresponds to output, as it is popularly termed today.
4. The evaluation system, which recognizes situations and generates action to stop pilferage, control waste, and develop policy based upon sales, cost and operating experience.

From this oversimplification, several secondary considerations will place in perspective the unsound claims that a multiplying variety of parallel, inadequate, and, for the most part, excessively costly developments in current management reporting and control technology will solve our problem. These secondary considerations emphasize the instantaneous character of the original sole-owner control. We might visualize him talking to another or, by extension, we might imagine any number of proprietors or data originating and processing centers "talking" to each other. In the sole proprietor's bio-mechanical system,

1. There is visual contact with input.
2. There is auditory or hearing contact with input.
3. Communication is instantaneous.
4. Processing capacity depends upon the size and speed of the memory.
5. Reports are drawn directly from memory for the most part, rather than being transcribed to paper for tedious and delayed perusal.
6. Action may be taken quickly without paperwork.
7. Input is largely accurate in the first three above, by reason of their inherent value to each other, but error

correction is poor in the rest.
8. The element of top managerial surveillance may intervene at any time in every component of the system.

Expensive (and Doubtful) Developments in Data Transmission

The quest for ways in which to utilize advanced equipment for better control communications goes on actively but not always effectively or along economical lines. Hundreds of engineers and management consultants across the country have been sinking millions of dollars into adapting known telephonic and telegraphic methods, along with paper tape or punched card originating equipment, to computer input. However, most of these devices lack vision, hearing, and instantaneousness in varying combinations or altogether. Furthermore, they really increase paperwork because they require paper to bridge from one to another, and this, in turn, imposes need for more hardware. The hardware, itself, has generated further input errors from compound circuitry and relays which sometimes fail. When errors occur, paper tapes impose exceptional difficulty in locating the point in question. A large insurance company indicates that it has discontinued paper tape transmission, for this reason, to return to cards. One supplier has announced a machine, or rather a number of machines circuited together, to produce cards and reports at various production points, but this system lacks vision and instantaneousness and, to couple it with logical (computing) ability, messengers will have to be hired to pick up the cards at each unit. Such a device, which cannot possibly be used full-time on a decentralized basis, rents for more per month than the wages of an average clerk.

There are other still more expensive ways to communicate. Even these, because communication to a data evaluation center is so vital to control, have been pressed into service. One such means is represented by pneumatic tubes, which cost up to several hundred dollars per installed lineal foot. They are all but inflexible, once set, and fixed charges for a substantial installation will equal the wages of a number of people. They also lack sound, which must be supplied by telephone auxilaries, and they lack the visual component altogether. Being built to transport physically full-scale paperwork, with its clerical preparation and timelag straits, they have relatively low transmission capacities.

Computers, Magnetic Storage — and the Input Problem

Moreover, communications must tend to some point, or points, of collection and evaluation. Hence, at this juncture, the data processing facility should be considered, i. e., how to use communicated data for comprehension and reaction. On a warship, this facility is a group of men and technological nerves to all quarters, termed a combat information center. In a plant, it is designated, variably, after many decades of progressive decentralization, as an office, whether mill, accounting, production control, shipping, or some other descriptive adjective. Superintendence of these offices has been centralized in waves as the spreading out process has caused them to become identifiably functionalized and, in this process, establishment or expansion of a staff function has coincided with each new wave. In all cases there is an input, mostly of paperwork. Communication channels are plant mail, telephone, pneumatic tubes, and conferences. In a few recent cases, paper tape is the medium. And, like the old telephone company advertisement, establishment of one new instrument where ten existed before required ten new lines of liaison, except that the lines have been lines of paper with clerks at both ends.

Electronic computers have entered this scene and are operating successfully in spite of the paperwork load at the input end but, so far, the most effective applications have been integrations of master data, which avoided a new flood of reports coming in. The latter are better absorbed into an integrated system over the time needed to redesign the basis of origination, Detailed liaison is needed all the way to the source in this endeavor. Once the paperwork has been adapted to the purpose, it can be readily filtered by a junior clerk with a keypunch machine so that the computer may be set up to handle the data. Data punching on this basis is duplication of effort, again using paper, but the costs are more than overcome by some integration in processing. Thus, the computer is no problem as far as its internal operation is concerned but, in drawing more paper through the door of the machine room, the communication problem is accentuated. And the key-punch group becomes packed tighter than office standards permit.

In the light of these factors the present and potential economics of computers must be considered. What processing problems do they solve? Like the sole proprietor, they communicate rapidly internally. They have substantial processing capacity. Reports may be drawn directly from memory with moderate and ever-improving speed for management action. The problem of error correction now lies mostly outside the system, once it is "debugged". Input both external and internal to the system and their very interrelationship develop as joint and several integration factors affecting computer capabilities. The integration

of production reports from two adjacent units, for example, means that the computer can automatically produce inventory data between units and, usually, more than half of the external repetitiveness in data origination can be eliminated. If production data be stored in a random access magnetic file, even the inventory reports can be eliminated, for all inventory data is available instantaneously and visually to anyone who has an interrogating connection between his office and the magnetic storage unit. If production orders were mechanized upon receipt, the external input concerning each order from each production process could be reduced about 65 per cent.[1]

Random access on the foregoing terms is a key point here. Announcements, since this paper began in preparation, have been most significant in terms of opening up the large random access memory capacity to provide memory characteristics like those of the sole proprietor. It appears that the economy of magnetic storage is already getting to a point at which it will appear cheaper than cards on many jobs, but caution in applying it is still needed. Still other recently announced developments are similarly indicative. One laboratory has a two-ended cathode ray tube with a metallic grid for permanent storage, capable of holding one million bits on a square-inch-screen. Its speed is great because one end reads while the other end writes, and the screen is so small. Such a development in production would render obsolete discs and drums as to speed, space requirements, and capacity, and even this would ultimately be excelled. Nuclear physicists chat about the ideal as calculation and perhaps storage in a matrix of differentially chargeable molecules. Not only would computers built on such principles exceed by a factor of thousands anything available today; they would be ridiculously compact for their capacity, and possibly inexpensive after perfection of the necessary manufacturing processes. The upshot is that commercial memories will, in the near future, be capable of relegating the detailed input of the business to storage for reference by the computing component as needed, just as in the sole proprietor's mind. But the tool will be expanded to the proportions of the economy as we know it, and it will be more capacious, more speedy and potentially less erroneous than the proprietor ever was. That is fine. However, its very instantaneousness is also silly if messengers are coming in eight to twenty-four hours late with the input.

---

[1]Based on a survey of two production centers made for purposes of this discussion. The percentage will vary depending upon the system and the degree of integration.

There is little purpose in not giving large scale instant storage an input when the event occurs, and this is the strongest argument against large centralized computer facilities until communication facilities can be improved.

Another factor of uselessness, i.e., irrelevance of advantages of speed and capacity, inheres in any lack of accuracy in input as long as computers are expensive. With an I. B. M. 650, for example, input may range up to a maximum of over 900,000 digits per hour. Even if only three of these are wrong enough to stop the machine and it takes only two minutes to correct each one, 10 per cent of the capacity has been lost. On larger machines this item is so important that some installations have a machine scheduler (the 705 does over 40,000 logical operations per second) to enforce nondelaying procedures. If an error stops the machine more than a very few minutes, the memory must be dumped by the hapless operator so that the next person in line may get to his problem. The price of delay is over $150 per hour.

These considerations reinforce the need for development of reliable, inexpensive, plant-wide data recording and transmission systems, which can provide audio and visual contact with low origination error ratio. It appears that such systems also may be the key to decentralization of memory elements of a unifiable computer complex in various locations. For example, if a number of memory devices can be hooked electronically into central, their distance from the unit is merely the length of the connection, and distance does not occasion the delays of traditional input-output via paper linkages. It is the instantaneous merging of plant-wide data that matters. Nevertheless, the best commercial use of a computer installation currently implies centralization because:

1. Personnel acquainted with the interaction of computer and commercial systems are too scarce and too expensive to "spread thin".
2. The new category of communications-data originating control expert which will have to be brought into existence in the manufacturing establishment does not exist, although materials are available to start training.
3. A large memory is not yet adequately adaptable to decentralization, which would remove it from the computing unit and the master file systems. A large magnetic memory is needed for paperwork elimination, rather than simplification, and elimination occurs when master files are integrated. Presently applied communications are not adequate, either in

terms of facilities or personnel, to assure high-speed integration of decentralized memory components with the presently developed heart of the system, i.e., cards, tapes, and programs.

4. Integration of related master data simultaneously reduces input error ratios and reduces the need for duplicating data from external sources.
5. The reduction of external input gained by centralized integration would reduce the load on the communication system, rendering it more effective for a given outlay.
6. Concentration of data improves computer payoff and builds necessary knowledge of techniques in the organization. The loading of a medium-size machine must be effected rapidly to justify the economy of larger equipment. Cost per calculation on a loaded 705 would be less than 10 per cent of that on a loaded 650, in terms of rental alone.
7. Larger capacity units handle greatly more complex logistical and research problems, which provide greater payoffs than straight commercial applications, to supplant today's generally unsophisticated analyses.
8. Complaints already have been heard that all of the fastest computers available cannot handle computer demand, either in terms of volume (this is on a national basis) or in terms of problem complexity. Advancement of the art is certain to bring more demands.

A Proposal for Control Communications by Monitored Television

The limitations in data transmission and input, along with other limitations which have just been described, would be discouraging, were it not that modern components are available to develop a reporting system lower in cost than any complex of traditional paperwork adapted to 50-year-old communications technology to ease its burden. Such a system can command the economy of integration in a high-speed processing organization, provide channels for extremely heavy volumes of transmission, and provide audio-visual contacts among many points. The proposal involves television cameras for data transmission. They may be obtained for prices under $1,000 per unit, ranging up to two or three times that amount for units having combinations of remotely controlled multiple turret lenses, sound, and weather protection components.

Scanning tube developments in recent months already have reduced prices. The industry, by means of printed circuits, other innovations, and volume demand for industrial applications, undoubtedly could cut prices 50 per cent in coming years. Units may be portable. They require no programming as in the case of tape or card punching gadgetry. Coaxial connections from cameras to monitors at about a dollar a foot would be far shorter and cheaper than multiple-circuited mechanical data originators wired to messenger service or connected all the way to central. Reliability of camera operation is superior and maintenance simple. If an unusual maintenance problem occurs, another unit may be plugged in while repairs are made.

In contrast to tape-punching equipment, which costs $2,000 to $4,000 per originator and receiver, a variety of forms can be transmitted by camera without programming, thus rendering floor data simultaneously adaptable to local use and data transmission within reasonable limits. The need for originators would be greatly condensed. If a number of stations are multiplexed to the monitor, multiplexing is electronic and visually instantaneous, whereas older devices multiplex mechanically and far more slowly. These characteristics are vital to high-speed, high volume data origination and processing, and also restore the opportunity for visual management surveillance of operations.

A description of what should happen to data will make the proposal concrete. Most readers will have observed that data origination is only a part-time job for many production recording clerks, although they are writing their reports in slow longhand. Because of this fact, a semi-centralized monitoring station (which would also really be a decentralized outpost of machine accounting), should be able to handle in practical fashion the data from ten or more points in the plant. For example, a common work situation at present is a recording 60 per cent to waiting 40 per cent ratio. Based upon the survey referred to in a previous paragraph, 65 per cent of the data formerly handwritten at all points would be in computer room master files — in the integrated system — and this would cut the data originating factor required for each point to 20 per cent at the monitor. At the monitor, the usual three-for-one speed advantage of keyed over handwritten data would apply, thus reducing the data origination time for each point monitored to an average of 6 2/3 per cent. This estimate is conservative, because it has not been factored further to adjust for better skilled personnel, or the enhancement of speed which occurs in the contemplated range of punches per item as a consequence of fewer keys activated per transaction, or for addition of totals formerly done by the mill recorder, as part of the original 60 per cent

work time, and now done in the computer.

It is seen that data relaying and visual switching from the monitors will depend upon a type of control communications personnel generally new to industry. To obtain the necessary accuracy for unimpeded volume of external input to the computer, it also is probable that these persons would perform every entry twice to obtain verification on the spot before triggering their transmissions. However, except for salary levels, these persons would cost nothing if their work were loaded properly. They would offset equivalent personnel otherwise employed in the machine room. Training of monitor personnel would correspond to that of, say, railroad telegraphers or nautical radiomen, and would cover data origination and control techniques, operating practices at points scanned in the local complex, and, to some extent, the computer programs for processing its particular data. The personnel would service, in reverse, any data from the central unit requested for local analysis or control purposes. It is likely that the data transmission component of carrier waves from monitors would preferably use key punching equipment or an adaptation. So far, it is better than other types of devices in reliability of operation. Monitors further would need policy enforced control or disciplinary procedures over the stations under their observation.

Completed entry and verification of weights, counts, and simple order indicia would be signalled from monitor to camera by a green light, advising the material handler that production has been recorded. From the monitor to the computer, a private micro-wave transmission system (these units also contain the camera multiplexing circuits) can be engineered economically for all but small plants. Simultaneous visual and data transmission on one carrier beam is obtainable either by "band splitting," which is using parts of the transmitter's wave band for different channels, or by use of extra transmitters. Thus, management could get visual contact, with one or more points per transmitter, without interrupting flow of data to the processing machine.

A transmitting-receiving combination with the necessary multiplexing system reportedly is available for $30,000 or less, although elaborate units cost more. If ultra-high frequencies (up to 10,000 megacycles are available) are used, signals may be beamed thirty miles with ridiculously low power — less than 10 watts — and by using only moderately high towers. The plant roof is often high enough to mount the antenna without constructing a tower. The high frequencies lie outside the range of static for all practical purposes. Compared with this medium, pneumatic tubes are poor. With the latter, coverage of a few points over a maximum range of 1000 feet may cost over $100,000 and have lower transmission capacity. The wavelength of a 10,000 megacycle frequency is about 1¼ inches. Transmitting-receiving antennas are "dishes" as small as a few inches in diameter and precisely aimed at each other.

Incoming data at the processing location would be recorded either on film (tapes) or go directly to random access storage. The data, although verified, might be occasionally erroneous, but a small residue of error can be corrected to some extent by the processing machine because of the integration of the system. Stock checks on the production floor would be minimized, compared with the present-day situation.

Most day-to-day reports to management, reduced by the programming of the system to exceptions, would be drawn from the processing machine in summary, and visual form only. Details would be fed out to operations visually for the most part, by a system of inquiry units. Data required for historical comparisons could be merged gradually into index or percentage figures. It is availability of figures such as these, now in relatively meager supply throughout industry, that helps the operating team to pull together for the best of the over-all enterprise.

Fully detailed data would be dumped periodically out of memory as needed for audit, or for permanent and minimized cost, financial, and inventory records.

Some Problems in Applicable Equipment and Methods

The television industry has concentrated on home receivers. As a consequence, all producers of equipment are largely standardized for a 525 line vidicon scanner, which cannot legibly transmit small print on many current business forms. This can be overcome by optical systems feeding smaller areas into the scanner or by redesign of the form to provide smaller volume of somewhat larger print in the transmission. Another tube called an image orthocon develops 750 lines for the screen, but it costs about $1,250 compared to about $280 for the vidicon. There is no question that finer scanners can be engineered for higher prices and that all prices will decrease over a period of time. Of course, the vidicon should be adequate for most purposes, although finer equipment is theoretically desirable for, say, fine photo-copy work if the data system develops around that particular technique.

(cont'd on page 38)

USE OF A COMPUTER FOR CERTAIN OPERATIONS OF CLASSIFICATION

Andrew D. Booth
Birkbeck College Computational Laboratory
University of London, London, England

It is proposed to examine, in this paper, the way in which an automatic digital computer can be applied to the resolution of two sorts of classification problems. The first problem is that of frequency analysis and, in particular, the making of what may be termed a 'concordance'. The second problem concerns the analysis of the structures of groups of words which may be likened to sentences occurring in a text.

At the outset it should be made clear that there is no difficulty in programming a computer to solve either of the problems if an adequate internal store is available. The interest arises when the problems have to be solved with limited storage capacity and where, because they arise in linguistic applications, the number of items to be classified may be very large.

Consider first the problem of frequency analysis. Here, in linguistic terms, it is necessary to list the numbers of different words which occur in a given text. It is to be imagined that the text to be analyzed is presented to the machine in the form of a punched or magnetic tape, and that on this, each alphabetic or other symbol is represented in a coded form acceptable to the machine. Each word is supposed to be terminated by a space symbol or by a punctuation mark whose code can be recognized by the machine as differing from that which represents a letter. If unlimited internal storage capacity is available the frequency analysis could proceed as follows:

Assume that, so far, n different words have been encountered in the text, and that the code symbols for these have been stored in locations $a + 1$, $a + 2$, ... $a + n$. Each location will be filled as:
(Code symbols) (Spare digits) (Count number).

The next word is now read from the tape, its end being recognized by the presence of a space or punctuation symbol. An attempt is now made to identify the word with one of the words already held in positions $a + 1$, $a + 2$, ... $a + n$; this can be most conveniently carried out by the method of 'Bracketing', first described by the author[1]. If the word is found to have occurred previously, in location $a + k$ say, unity is added to the count number held in that position. If, however, the word has not occurred previously, it is stored in position $a + n + 1$ and a count number 1 is placed in the relevant count number position.

This process is continued until the end of the tape is reached, at which point the words and their count numbers are either output directly, or sorted into alphabetic or frequency order and then printed out.

When only limited internal storage is available this simple process is impossible, but it has been found that the following variant gives satisfactory results. It is assumed that the available internal storage extends from $a + 1$ to $a + L$.

(a) Read the next word from the input tape.
(b) Compare with words already stored.
(c,1) If previously encountered, add unity to the relevant count number and return to (a).
(c,2) If not previously encountered, test to see if available storage is filled.
(d,1) If storage is available record word and unit count number in next unfilled location. Record filling of additional storage space and return to (a).
(d,2) If storage is full punch out, or otherwise record, the word on output tape. Return to (a).

It is clear that the result of this process will be an analysis of the frequency of occurrence of the first L different words to be used in the text, and a new tape from which these words have been eliminated. The process is now repeated on the derivative tape and the cycle repeated until all of the text has been dealt with.

The more general problem of preparing a concordance involves, not only the statistical

analysis described above, but also the provision of a list of page and line numbers on which each word appears. This can be handled in a precisely similar way but involves the use of several computer storage locations to hold the data for each text word. The input tape is now provided with page and line end symbols and these are used to insert the necessary concordance data into the storage locations associated with the word under examination. The program of operations is as follows:

(a) Read symbol from tape.
(b) Examine to see if it is:
  1. Line start symbol, if so go to (c.1).
  2. Page start symbol, if so go to (c.2).
  3. Alphabetic symbol, if so store with previous symbols and go to (a).
  4. Space symbol or punctuation mark, if so go to (d).
(c,1) Increase current line count number held in store by unity, punch line start symbol on output tape and return to (a).
(c,2) Increase current page count number held in store by unity; reset line count number to unity, punch page start symbol on output tape and return to (a).
(d) Compare assembled word with words already stored, if present go to (e,1), if absent to (e,2).
(e,1) Increase frequency count number by unity, insert page and line count numbers in storage, return to (a).
(e,2) Examine "storage occupied" count number. If it has not reached the permissible limit, increase it by unity and store the new word, page and line numbers and unity frequency count number in the next storage location. If the permissible limit has been reached, punch the word onto the output tape and return to (a).

It is evident that the program just given will result in an output which treats the various forms of any word (singular, plural, etc.) as different entities. If it is desired to avoid this, all that is necessary is to provide the machine with a stem dictionary(2) which will enable the various forms of a word to be recognized. Since, however, programs of this type are generally used to make analyses preliminary to the construction of the stem-ending dictionary, it is frequently more useful to produce the full output in alphabetical order. The effect of this is, in general, to associate all forms derived from the same stem in adjacent positions, which is a considerable aid to the ensuing analysis.

For the second of the two problems mentioned at the outset, the following may be taken as typical: It is required to examine a given text and to produce a list of all sentences (or phrases) having a given structure. Here again, given unlimited storage space, the problem can be solved in a straightforward manner. Assume that the machine holds in store a dictionary which associates each word with a part-of-speech or other grammatical symbol. The problem is to recognize a given configuration, say (s_1, s_2, ...s_n), in the input and to list this as and when it occurs. A simple program would be:

(a) Read and store all words up to the next punctuation mark.
(b) Compare words, in sequence, with dictionary and thus obtain grammatical indication numbers.
(c) Compare indication numbers with (s_1,s_2, ...s_n). If identical, output the given sentence and return to (a); if not return to (a) directly.

With most modern machines this method of approach is quite practicable since structural groups are, in general, not very large. The disadvantage lies in the fact that the program required to handle variable length sentences tends to be complicated. To overcome this the following procedure has been evolved:

(a) Read in the next word and punch it on to the output tape.
(b) Compare with dictionary to obtain grammatical symbol.
(c) Compare grammatical symbol with the appropriate configuration symbol, s_r say. Test to see if s_r is the last unit of structure to be considered.
(d,1) If the configuration symbols are identical, and s_r is not the last unit of structure, return to (a).
(d,2) If symbols are not identical continue reading and punching until the next punctuation mark is reached; punch this out and return to (a).
(d,3) If the symbols are identical, and s_r is the last unit of structure, continue reading and punching until the next punctuation mark is reached. Punch this out twice in succession and then return to (a).

The output tape produced by this process will contain the original text marked in such a way that each structural unit of the required type is followed by a double punctuation mark. This tape is now fed to the machine backwards

(cont'd on page 37)

ROBOTS AND AUTOMATA: A SHORT HISTORY

James T. Culbertson
California State Polytechnic College
San Luis Obispo, Calif.

(Part 1 of this article with numbered references appeared in the March issue, and consisted of the first chapter of a forthcoming book, "The Minds of Robots: Behavior and Sense Data in Hypothetical Automata". The whole bibliography of the book is here included in Part 2; the numbers used in Part 1 agree with the numbers here.)

BIBLIOGRAPHY

1. Adrian, E.D.; The Physical Background of Perception; Oxford University Press; 1947
2. Ashby, W.R.; Design for a Brain; New York: Wiley, 1952
3. Attneave, Fred; Some Information Aspects of Visual Perception; Psychological Review; Vol. 61, No. 3, 1954
4. Bacon, Francis; The New Atlantis
5. Bakewell, C.M.; Source Book in Ancient Philosophy, Scribners, 1907
6. Bales, Fried
7. Bavink, B.; The Natural Sciences, Appleton-Century, 1932
8. Berkeley, E.C.; Giant Brains. New York: Wiley, 1949
9. Berkeley, Bishop; Principles of Human Knowledge, Sections 1, 2, 4, 6, 8, 23
10. Boring, E.G.; The Physical Dimensions of Consciousness; New York; Century, 1933
11. Boring, E.G.; Sensation and Perception in the History of Experimental Psychology; New York; Appleton-Century Co., 1942
12. Brewster, Sir David; Letters on Natural Magic; Harper Brothers; New York, 1870
13. Brunswik, E.; The Conceptual Framework of Psychology; Chicago: University of Chicago Press, 1952
14. Bulletin of Mathematical Biophysics; Edited by N. Rashevsky; University of Chicago Press; numerous articles especially since about 1942
15. Bullfinch's Mythology, Chap. II
16. Carnap, R.; Logical Foundations of the Unity of Science; Encyclopaedia of Unified Science; Vol. I, No. 1, Univ. of Chicago Press; 1934
17. Castiglioni, Arturo; A History of Medicine (translated by E.B. Krumbhaar)Alfred A. Knopf; New York, 1947
18. Chambers Miscellany of Useful and Entertaining Knowledge, Gould Kendall and Lincoln, (No date)
19. Churchman, C. West
20. Cohen and Drabkin: Source Book in Greek Science; McGraw-Hill, 1948 (Note also Aulus Gellius Attic Nights X)
21. Culbertson, JT.; A Physical Theory of Sensation; Journal of Philosophy of Science; Vol. 9, No. 2, April, 1942
22. Culbertson, JT.; Distances and Qualities in Perceptual Space, Journal of Psychology, Jan., 1945
23. Culbertson, J.T.; Temporal Change in Perpetual Space, Journal of Psychology, Jan., 1946
24. Culbertson, J.T.; A Device for Optic Nerve Conduction and Form Perception I; Bulletin of Mathematical Biophysics, June, 1948
25. Culbertson, J.T.; A Device for Optic Nerve Conduction and Form Perception II; Bulletin of Mathematical Biophysics, June, 1948
26. Culbertson, J.T.; Consciousness and Behavior; Wm. C. Brown Co., 1950
27. Culbertson, J.T.; Flicker and Fusion in a Hypothetical Device for Light Intensity Discrimination; RAND paper RM-744, Nov., 1951
28. Culbertson, J.T.; Hypothetical Robots and the Problem of Neuroeconomy; RAND Project P-296, April, 1952
29. Culbertson, J.T.; Memoryless Robots; RAND Paper P-316, Aug., 1952
30. Culbertson, J.T.; Sense Data in Robots and Organisms; RAND Paper P-378, May, 1953
31. d'Abro, A.; Evolution of Scientific Thought, Liveright, 1927
32. Descartes (Letter from Gassendi to Descartes, 1641, quoted by Descartes in Objections and Replies; See Philosophical Works of Descartes, trans. E.S. Haldane and ?, Cambridge University Press, 1912, v. 2 pp. 201-02. Quoted in The Spirit of Western Philosophy, Stallknecht and Brumbaugh, Longmans, Green & Co., 1950, p. 274)
33. Dotterer, R.H.; Philosophy by Way of the Sciences. New York; MacMillan, 1929. p. 197ff.
34. Dudley, H., and Tarnoczy, T.H., "The Speaking Machine of Wolfgang von Kempelen"; Bell Telephone System Technical Publications, Monograph, 1734. Copyright, 1950, Acoustical Society of America
35. Eddington, A; Nature of the Physical World, New York, MacMillan, 1929
36. Edinburgh Encyclopedia, 1843

37. Einstein, A.; Relativity, Holt, 1931, p. 65.
38. Encyclopedia Universal Ilustrada, Madrid, Article on Automata
39. Feigl, Herbert
40. Flood, Merrill, Refer to RAND paper
41. Gassendi; See Descartes
42. Gerard, R.W.; Scientific Monthly, 62:477, 1946
43. Gerard, ; Caesar; Charles Scribner's Sons, 1952; Page 544
44. Gibson, James J.; The Perception of the Visual World; Houghton Mifflin, 1950
45. Granit, R.; Sensory Mechanisms of the Retina; Oxford Univ. Press, London, 1947
46. Gregory, J.C.; Short History of Atomism, A. and C. Black, London, 1931, Chap. 5.
47. Grey-Walter, ; The Living Brain, W.W. Norton & Co., Inc., 1953
48. Hartline, H.K.; Nerve Messages in the Fibers of the Visual Pathway, Journal of the Optical Society of America, 30, 239-247 (1940)
49. Hayek, F.A.; The Sensory Order; University of Chicago Press, Chicago, 1952
50. Hebb, D.O.; The Organization of Behavior; New York; Wiley, 1949
51. Helmholtz, H. von; Physiological Optics (trans. J.P.C. Southall) Optical Society of America, 1924
52. Householder, A.S.; RAND paper RM-671 Neural Nets for Toad T1, 1951. RAND paper RM-678 Pavlovian Learning, 1951
53. Householder, A.S. and Landahl, H.D.; Mathematical Biophysics of the Central Nervous System. Principia Press, 1945
54. Huxley, T.H.; Science and Culture; 1881
55. James, William; The Principles of Psychology; New York: Henry Holt & Co., 1890
56. Kaempffert, Waldemar, Explorations in Science; New York; The Viking Press; 1953, Page 283
57. Kaplan, A.
58. Kleene, S.C.; Representation of Events in Nerve Nets and Finite Automata, RAND paper RM-704, Dec., 1951
59. Kluever, H.; Behavior Mechanisms of Monkeys; Univ. of Chicago Press; 1933
60. Lashley, K.S.; In Search of the Engram, in "Physiological Mechanisms in Animal Behavior," New York, Academic Press, Inc., 1950
61. Lashley, K.S.; Functional Interpretations of Anatomic Patterns, in "Patterns of Organization in the Central Nervous System", Philip Bard, Editor. Baltimore; Williams and Wilkins Co., 1952
62. Leibnitz Mondology
63. Loeb, J.; Forced Movements, Tropisms and Animal Conduct
64. Lovejoy, A.O.; The Revolt Against Dualism, Open Court, 1930
65. Major, D.R.; Introduction to Philosophy, Odyssey Press, 1933
66. Manning, H.P.; Geometry of Four Dimensions, MacMillan, 1914
67. Margenau, H.; The Nature of Physical Reality, McGraw-Hill, 1950
68. McCullough, W.S. and Pitts, W.; A Logical Calculus of Ideas Immanent in Nervous Activity; Bulletin of Mathematical Biophysics 5, 1943
68a. McCullough, W.S. and Pitts, W.; How We Know Universals
69. McCurdy, Edward; The Mind of Leonardo da Vinci; Dodd, Mead, and Co., 1948
70. McDougall, William; Body and Mind; New York; MacMillan Co., 1920
71. Mead, H.; Types and Problems of Philosophy; Henry Holt & Co., 1946
72. Mettler, C.C.; History of Medicine; Blakeston Co., 1947
73. Miessner, B.F.; From Electrical Experimenter, Sept., 1915, p. 202
74. Northrop, F.S.C.; Science and First Principles, MacMillan, 1931
75. Northrop, F.S.C.; Science, 107:411, 1948
76. Parry, T.W.; The Prehistoric Trephined Skulls of Great Britain; Proc. Roy. Soc. Med. (Hist. Sect.) Vol. XIV, Suppl, (London, 1921)
77. Patrick, G.W.W.; Introduction to Philosophy; Houghton Mifflin, 1936
78. Penfield, W. and Rasmussen, T.; The Cerebral Cortex of Man; MacMillan, 1950
79. Pirenne, M.H.; Vision and the Eye; Pilot, London, 1948
80. Poe, E.A.; Maelzel's Chess Player
81. Polyak, S.; The Retina; Univ of Chicago Press, 1941
82. Quastler, Henry (editor); Information Theory in Biology; Univ. of Illinois Press, Urbana, 1953
83. Rapoport, A and Shimbel, A.; Cybernetics and Mathematical Biology, in ETC., a Review of General Semantics, Spring, 1949
84. Rapoport, A.; Operational Philosophy, Harpers, 1953
85. Rashevsky, N.; Mathematical Biophysics, 1948, Part Three
86. Rosenblueth, Wiener and Bigelow; Journal of the Philosophy of Science, 1943, 10, 18
87. Russell, B.; Human Knowledge; New York, Simon and Schuster, Inc., 1948
88. Sarton, George; History of Science; Vol. I, Carnegie Institute, 1927
89. Schrodinger, E.; Science and Humanism; Cambridge, 1951
90. Shannon, C.E. and Weaver, W.; Mathemat-

ical Theory of Communication; Univ. of Illinois Press, 1949

91. Sherrington, C.; The Integrative Action of the Nervous System; Yale Univ. Press, New Haven, 1920
92. Sperry, R. W.; Neurology and the Mind-Brain Problem; American Scientist, Vol. 40, No. 2, April, 1952
93. Stallknecht and Brumbaugh, the Spirit of Western Philosophy; Longmans, Green and Co., 1950
94. Swift, J ; Gulliver's Travels, Part III
95. Tarski, Alfred; Introduction to Logic, New York, 1941
96. Titus, H. H.; Living Issues in Philosophy; American Book Co., 2nd ed., 1953
97. Tolman, E. C.; Purposive Behavior in Animals and Men; New York, Century 1932
98. Tornebohm, H.; A Logical Analysis of the Theory of Relativity; Stockholm; Almquist and Wiksell, 1952
99. Troland, L. T.; The Principles of Psychophysiology; New York, Van Nostrand, 1932
100. Turing, A. M.; Computing Machinery and Intelligence; MIND, Oct. 1950
101. Von Foerster, H. (editor) Cybernetics, Circular Causal and Feedback Mechanisms in Biological and Social Systems; Transactions of the Sixty Conference, 1949; Josiah Macy Jr. Foundation
102. von Kempelin
103. von Neumann, J.; The General and Logical Theory of Automata, in "Cerebral Mechanisms in Behavior, Hixon Symposium, New York, John Wiley and Sons, 1951
104. von Neumann, J.; Probabilistic Logics, California Institute of Technology Lectures, Jan., 1952
105. Wiener, N.; Cybernetics, N. Y., Wiley, 1948
106. Wiener, N.; The Human Use of Human Beings, Houghton-Mifflin, 1950
107. Willis
108. Woodger, J. H.; Axiomatic Method in Biology; Cambridge Univ. Press, 1937
109. Descartes; Passions of the Soul XXXIV
110. Creegan, R. F.; (R)-systems versus Psychological Spaces; Journal of Philosophy of Science, Oct., 1942
111. Morgan and Steller; Physiological Psychology, McGraw-Hill, 1950
112. Hurewicz, W. and Wallman, H., Dimension Theory, Princeton Univ. Press, 1941, Page 4
113. Manning, H. P.; Geometry of Four Dimensions, MacMillan, 1914
114. Barnett, L.; The Universe and Dr. Einstein, Sloane, 1948, Chap. 9
115. Jeans, J.; The Mysterious Universe, Cambridge Univ. Press, New Revised Edition, 1932, pp. 117-121
116. Korzybski, A.; Science and Sanity, 2nd Ed., 1941, pp. 626-630
117. Russell, B.; The ABC of Relativity, Keagan Paul, 1927, p. 58ff.
118. d'Abro, A.; Evolution of Scientific Thought, Boni and Liveright, 1927, Chap. XVIII. Note discussion of point- event and world-line
119. Minkowski, H.; In the Principle of Relativity by A. Einstein and Others, Methuen & Co., London, 1923, page 75
120. Steinmetz, C. P.; Relativity and Space, McGraw-Hill, 1923, p. 24
121. Margenau, H.; The Nature of Physical Reality, McGraw-Hill, 1950, p. 150
122. Fitch, F. B.; Physical Continuity. Philosophy of Science, 3, No. 4, Oct., 1936, 486-494
123. Biser, I.; A general Schema for Natural Systems. Philadelphia, Westbrook Publishing Co., 1938
124. Hinton, C. H.; The Fourth Dimension. London: Swann Sonnenshein & Co., Ltd., 1904
125. Hobbes, T.; Leviathan. London: J. M. Dent, 1924
126. Lucretius; De Rerum Natura. English translation by W. H. D. Rouse. London: W. Heinemann, 1931
127. Thompson, D'Arcy W.; On Growth and Form. Cambridge
128. Culbertson, J. T.; The place of the sense world in physical theory; Ph. D. Thesis. Yale University, 1940
129. Bowden, B. V.; Faster Than Thought, Pitman & Sons, London, 1953
130. Lewin, K.; Principles of Topological Psychology, McGraw-Hill, 1936
131. Gerard, Ralph W.; What is memory? Scientific American, Sept. 1953
132. Fulton, J. R.; Physiology of the Nervous System; 2nd Edition. New York: Oxford Univ. Press. 1943
133. Watson, J. B.; Behaviorism. New York: Norton
134. Mead, Shepherd; The Big Ball of Wax; Simon & Schuster; New York, 1954. p. 109ff
135. McCloy, Shelby T.; French Inventions of the Eighteenth Century; Univ. of Kentucky Press, 1952. Chap. VIII on automata.
136. Sinnott, E. W.; Cell and Psyche, Univ. of North Carolina Press, 1950
137. Bonner, J. T.; Morphogenesis, Princeton Univ. Press, 1952
138. Culbertson, J. T.; Some Uneconomical Robots. In Automata Studies, Edited by

Shannon, C.E., and McCarty, J. Princeton Univ. Press, 1956
139. Booth, A.D. and Booth, K.H.V.; Automatic Digital Computers; Butterworths Scientific Publications, 1953
140. Computers and Automation. Monthly Periodical. E.C. Berkeley & Associates
141. Abbott, John A. Electroencephalography. Reprinted from New England Journal of Medicine; Jan. 6 and Jan. 13, 1955
142. Report of Committee on Colorimetry for 1920-21. Journal of the Optical Society of America and Review of Scientific Instruments. Aug. 1922, 6 p. 535
143. Bulletin of Mathematical Biophysics. Ed N. Rashevsky
144. Frankel, Stanley; On the Design of Automata and the Interpretation of Cerebral Behavior. Psychometrika, Vol. 20, Number 2, June 1955
145. MacKay, D.M.; Mindlike Behavior in Artefacts. British Journal for the Philosophy of Science, 1951, II, p 108
146. Thrall, R.M., Coombs, C.H., and Davis, R.L.; Editors Decision Processes, Wiley, New York, 1954
147. Brain, W. Russell; Mind, Perception and Science; Blackwell Scientific Publications, Oxford, 1951
148. Richter, D., Editor; Perspectives in Neuropsychiatry; Lewis, London, 1950
149. Von Neumann, J. and Morgenstern, O.; Theory of Games and Economic Behavior. Princeton University Press, 1944
150. Babbage, H.P.; Babbage's Calculating Engines. London: E. and F.N. Spon., 1889
151. Watson, G.; "Apparent Motion and the Mind-Body Problem", British Journal for the Philosophy of Science, Vol. II, No. 7
152. Shannon, C.E. and McCarthy, eds.; Automata Studies, Princeton University Press, 1956
153. McKay, D.M.; "The Epistemological Problem for Automata". In Automata Studies, Edited by Shannon, C.E., and McCarthy, J., Princeton University Press, 1956
154. Muller, D.E.; "Complexity in Electronic Switching Circuits", I.R.E. Transactions on Electronic Computers, March, 1956
155. Minsky, M.L.; "Some Universal Elements for Finite Automata". In Automata Studies, Edited by Shannon, C.E. and McCarthy, J., Princeton University Press, 1956
156. Moore, E.F.; "Gedanken-Experiments on Sequential Machines". In Automata Studies, Edited by Shannon, C.E. and McCarthy, J., Princeton University Press, 1956
157. Turing, A.M. "On Computable Numbers". Proc. of the London Mathematical Society 2, 42 (1936)
158. McColl, L.A.; Fundamental Theory of Servomechanisms. Van Nostrand, 1945
159. Huxley, A; Brave New World
160. Young, J.Z.; Doubt and Certainty in Science. Clarendon Press, 1951
161. Maxwell, J.C.; "On Governors". Proc. Roy. Soc. 16, 270, 1868
162. Hazen, H.L.; "Theory of Servomechanisms". J. Franklin Institute, 218, 279, 1934
163. Ahrendt, W.R.; Servomechanism Practice, McGraw-Hill, 1954
164. Richards, R.K.; Arithmetic Operations in Digital Computers, Van Nostrand, 1955
165. Pierce, John R.; Book review, Scientific American, Aug., 1956
166. Tsien, H.S.; Engineering Cybernetics, McGraw-Hill, 1954
167. Diebold, J.; Automation, Van Nostrand, 1952
168. West, J.C.; Textbook of Servomechanisms, English Universities Press Ltd., 1953
169. Soule, G.; Time for Living, Viking Press, 1955
170. Cleator, P.E.; The Robot Era, Allen and Unwin, 1955
171. Greene, J.; "Man as a servocomponent", Control Engineering, Oct., 1954
172. Tustin, A; "Feedback", Scientific American, 187: 48-55, Sept., 1952
173. Butler, Samuel; Erehwon, N.Y., Nelson, 1901
174. Rapoport, A.; "Technological Models of the Nervous System". ETC., Sept., 1954
175. Pierce, John R.; Electrons, Waves and Messages. Hanover House, Garden City, New York, 1956
176. Berkeley, E.C. and Wainwright, L.; Computers, Their Operation and Applications, Reinhold Publishing Co., New York, 1956
177. Aiken, H.H. and others; Description of a Magnetic Drum Calculator. Harvard Univ. Press, 1952
178. Allport, R.H.; Theories of Perception and the Concept of Structure. Wiley, 1955
179. Allport, F.H.; The Structuring of Events. Psychol. Rev. 61, 1954
180. Adrian, E.D.; Bremer, F. and Jasper, H.H., Editors; Brain Mechanisms and Consciousness. Blackwell Scientific Publications. Oxford, 1954
181. Kohler, W. and Held, R.; The Cortical Correlate of Pattern Vision. Science, 110, 414-419. 1949
182. Lorente de No, R.; Analysis of the Activity

of Chains of Internuncial Neurons. J. Neurophysiology 7, 1938

183. Schrodinger, E; What Is Life? New York. MacMillan, 1946

184. Titchener, E. B.; Experimental Psychology of the Thought Processes; MacMillan, 1909

185. Titchener, E. B.; A Textbook of Psychology, MacMillan, 1914

186. Tolman, E. C. and Brunswik, E.; The Organism and the Causal Texture of the Environment. Psych. Rev., 42, 1935

187. Adrian, E. D.; Rhythmic Discharges from the Thalamus. J. Physiology, 113, 1951

188. Bartley, S. H.; Vision. Van Nostrand, 1941

189. Pavlov, I. P.; Lectures on Conditioned Reflexes. Conditioned Reflexes and Psychiatry. Translated and edited by W. H. Gantt. New York. International Publishing Co., 1942

190. Laslett, Peter, Editor; The Physical Basis of Mind. MacMillan, 1950

191. Culbertson, J. T.; Mathematics for Digital Devices. (Text now used in mimeographed form for two undergraduate courses at California State Polytechnic College. To be published for fall 1957)

192. Engineering Research Associates; High Speed Computing Devices. McGraw-Hill, 1950

193. Keister, W., Ritchie, A. E. and Washburn, S. H.; The Design of Switching Circuits, Van Nostrand, 1951

194. "Review of Input and Output Equipment Used in Computing Systems", Joint AIEE-IRE-ACM Computer Conference, 142 pages Dec. 1952. (Published March 1953)

195. Proceedings of the IRE, Computer Issue, Oct., 1953

196. "A Survey of Automatic Digital Computers", Report 111293, U. S. Dept. of Commerce, Office of Technical Services, Washington 25, D. C.

197. Brain, W. R.; Neurological Approach to Perception. Philosophy, 1946, 21, 133

198. Whitehead, A. N.; Process and Reality, MacMillan, 1936

199. Brain, W. R.; Cerebral Basis of Consciousness, Brain, 1950, 73, 461

200. Physiological Mechanisms in Animal Behavior, Editors, Cambridge, 1950

201. Locke, J.; Essay Concerning Human Understanding; Open Court, 1927

202. Kant, I.; Critique of Pure Reason, Translated by Max Muller, MacMillan, 1925

203. Mach, E.; Analysis of Sensations, Translated by C. M. Williams, Open Court, 1897

204. Broad, C. D.; Scientific Thought, Harcourt, Brace, and Co., 1927. Chaps. 8, 9, 10

205. Haeckel, E.; Riddle of the Universe, Harpers, 1902, Chap. 10

206. Parish, E.; Hallucinations and Illusions, Scribners, 1897

207. Eddington, A. S.; Space, Time and Gravitation; Cambridge Univ. Press, 1935, Chap. 3

208. Lewis, G. N.; The Anatomy of Science, Yale Univ. Press, 1929

209. Ramsperger, A. G.; Philosophies of Science, Crofts, 1942, Chap. 4

210. Reiser, O. L.; The Alchemy of Light and Color, Norton, 1928

211. Hume, D.; Treatise of Human Nature, Everyman's Library, 1930

212. Carnap, R.; Scheinprobleme in der Philosophie, Weltkreis-Verlag, Berlin, 1928

213. Poincare, H.; Science and Hypothesis, Dover Publications, 1952

214. Weyl, H.; Space-Time-Matter, Methuen, 1922

215. Alexander, S.; Space, Time and Deity, MacMillan, 1934

216. Johnson, S.; Rasselas, Oxford Univ. Press, 1949, Chap. XLVIII

217. Steward, Dugald; Works. Edited by W. Hamilton, 1858

218. Sarisberiensis, J.; Collected Works, Edited by Giles, J. A., Oxford, 1848. (John of Salisbury's 12th Century associational psychology.)

219. Comte, A.; Fundamental Principles of Positive Philosophy. Translated by P. Descours and H. G. Jones, London, 1905

220. Kohler, W.; The Place of Value in a World of Facts, Liveright, 1938

221. Plato; Dialogues. Trans. by B. Jowett Five Vols., Oxford Univ. Press, 1931. Theaetetus, pp. 151-154, 156-161, 182

222. Brillouin, Leon; Science and Information Theory, Academic Press, 1956

223. Granit, R.; Receptors and Sensory Perception, Yale Univ. Press, 1955

224. Attneave, Fred; Amer. Journal of Psychology, 68, 69-82, 1955

225. von Bonin, G.; Essay on the Cerebral Cortex, Springfield, Ill., Charles Thomas, Publisher, 1950

226. Cobb, Stanley; On the Nature and Locus of Mind, Archives of Neurology and Psychiatry, Vol. 67, 1952

227. Brazier, M. A. B.; A Neuronal Basis of Ideas, Dialectica 4:73, 1950

228. Gerard, R. W.; Brain Physiology: A Basic Science; In Changing Concepts of Psychoanalytic Medicine; Grune and Stratton, 1956

229. von Bonin, G.; Notes on Cortical Evolution, Archives Neurology and Psychiatry, Vol. 67, Feb. 1952

230. Penfield, W.; Memory Mechanisms, Ar-

(cont'd on page 38)

WESTERN JOINT COMPUTER CONFERENCE, LOS ANGELES, FEB. 26 TO FEB. 28, 1957, PROGRAMS, TITLES, AND ABSTRACTS

The 1957 Western Joint Computer Conference took place at the Statler Hotel, Los Angeles, Calif., February 26 to February 28, 1957. Following is the program, sponsored jointly by the Institute of Radio Engineers, the American Institute of Electrical Engineering, and the Association for Computing Machinery. All registrants receive a free copy of the proceedings. Others may order a copy of the proceedings from any of the three sponsoring societies, such as the Association for Computing Machinery, 2 East 63 St., New York 21, N. Y. (The following numbers of papers were not in the program, but have been added, for convenience in reference, by the editor of "Computers and Automation".)

Tuesday Morning

1. Welcome, J. L. Barnes, System Laboratories Corp., Conference Chairman

2. Keynote Address, J. M. Bridges, Director of Electronics, Application Engineering Office of the Assistant Secretary of Defense

Tuesday Afternoon
SESSION I: MATHEMATICS OF RELIABILITY
Edward Coleman, UCLA, Chairman

3. "Reliability from a System Point of View", A. W. Boldyreff, The Rand Corp. -- The basic concepts of reliability are defined critically and the present status of reliability of complex equipment is accessed. The emphasis is on treating reliability as one of the system parameters, all of which have to be properly balanced in optimum system designs.

4. "Design of Experiments for Evaluating Reliability", J. F. Hoffmann, System Laboratories Corp. — Some of the basic philosophy of experimentation is discussed, and the role of statistics in the analysis and interpretation of experimental data is outlined. A hypothetical experiment reveals the methods by which statisticians organize experimentation in order to simplify analysis and maximize information obtained.

Completely randomized, randomized blocks, Latin and Greco-Latin square designs and their associated analyses for single factor experiments are discussed briefly. The organization of multiple factor experiments is illustrated by the discussion of a factorial experiment involving use of split plots. The role and necessity of randomization is emphasized.

5. "Reliability and Computers", W. H. Ware, The Rand Corp. — The problem of reliability in a computing system is examined, and the contrast between analog and digital systems in this respect is discussed. The application of the two previous papers to providing reliable computing system operation is developed.

SESSION II: NEW SYSTEMS A
Robert Johnson, General Electric Co., Chairman

6. "A Digital System Simulator", W. E. Smith, Aeronutronic Systems, Inc. — The digital systems simulator is a device for simulating any digital system which is capable of being represented by flip-flops and and/or decision elements, or more generally speaking by memory and logic. No physical changes are required in causing this simulator to assume the characteristics of various systems. All changes are done by coding or programming into memory. Extensions to the capacity of the device for representing systems beyond a certain complexity involve minor physical changes and an increase in the memory storage space.

7. "A New Input-Output Selection System for Florida Automatic Computer (FLAC)", C. F. Summer, RCA Missile Test Project — Details of a new high speed input-output selection system are presented. The basic computer characteristics and the construction of the computer word are described. This information is then related to factors which dictate the design of the logic necessary to control the selection matrix. Characteristics are

also presented on a new high speed reliable relay with replacement hermetically sealed contacts. Finally, illustrations are included which cover the logic and selection matrix, the new relay package, finished chassis and an over-all view of the ultimate computer layout.

8. "The IBM 650 RAMAC System - Disk Storage Operation", D. Royse, IBM — This paper describes the operation of a single-step data processing system. Elements of the system are a flexible medium-speed stored-program computer, and a six to twenty-four-million-digit memory composed of one or more magnetic-disk storage-arrays. The paper reviews the basic computer and the disk-storage units. The computer's control of seek, read, and write memory operations is described with emphasis on speed and reliability considerations.

9. "The IBM 650 RAMAC System - Inquiry Station Operation", H. A. Reitfort, IBM — The Inquiry Station provides quick access to the data processing system from remote locations. The system consists of a transmitting-receiving typewriter operating through a control unit which synchronizes the Inquiry Station and the IBM 650 RAMAC. Typed information under control of a format tape in the typewriter is stored on the magnetic drum for processing in the computer. The results are sent back to the typewriter and automatically typed under control of the format tape. The system has flexibility and provides quick access to any or all records stored in the RAMAC.

Wednesday Morning
SESSION III: NEW COMPONENTS
Cornelius Leondes, UCLA, Chairman

10. "An RCA High-Performance Tape Transport System", S. Baybick and R. E. Montijo, RCA — A high-performance, multi-channel digital tape transport was developed to meet the needs of the data processing industry in general. This is a tubeless equipment using semiconductor and magnetic components.

This paper describes the electronics and mechanism in detail, including the methods employed in obtaining start-stop rates to 120 per second, start and stop times of less than 12 milliseconds, and a start-stop spacing of less than 0.2 inches. The transport handles various widths of tape from 1/2" to 1 1/8" and magnetic heads which provide up to 18 recording tracks.

11. "A Medium Speed Magnetic Core Memory", G. E. Valenty, Remington Rand Univac — The completely transistorized type S3 magnetic core memory designed and built by Remington Rand Univac for the Transac S1000 computer uses 1145 transistors, consumes 300 watts, and occupies 4 cubic feet. A timing device utilizing magnetic switch cores has been developed to sequence the memory operation. A memory cycle requires 20 microseconds and the word is available after 6 microseconds. The logical circuitry consists of diode "and" and "or" circuitry plus transistor amplifiers. Low and high frequency transistors are employed to generate well regulated constant current pulses to drive the memory.

12. "Millimicrosecond Transistor Switching Techniques", E. J. Slobodzinski and H. S. Yourke, IBM Research Center — A program was initiated to develop semiconductor circuitry capable of performing five sequential logical operations in 100 milliseconds. The advent of the drift transistor and improved current switching techniques have made these goals feasible. The design philosophy that resulted from this investigation will be discussed. Circuits will be shown that are not critical with respect to variations in alpha and Ico. The driving capabilities and switching speeds of these circuits will be discussed.

13. "The Utilization of Magnetic Domain Wall Viscosity in Data Handling Devices", V. L. Newhouse, RCA — The investigation of the switching behavior of metal tape rectangular loop cores in the millimicrosecond region has led to the discovery of a group of phenomena collectively referred to as the magnetic inertia effects.

Various digital circuit applications are described. These include a technique of continuously displaying the contents of magnetic shift registers and increasing the speed of operating random access memories without an increase in the amount of equipment required, and without the use of extra windings or of a special core geometry.

SESSION IV: APPLICATIONS OF RELIABILITY PRINCIPLES
Gilbert D. McCann, Calif. Inst. Tech, Chairman

14. "Reliability in Business Systems", H. T. Glantz, J. Diebold & Associates, Inc. — Although general agreement exists that scientific and commercial data processing systems are different, the precise nature of these variations, with their resulting implications, has not yet been clearly defined. One reason for this is that business data processing systems are used for such a wide variety of applications, with each system operating under the restraint of a number of unrelated but dogmatic outside agencies (I.C.C., S.E.C., Bureau of Internal Revenue, etc.); utilizing data that is frequently uncontrollable as to format, scheduling, or accuracy; and facing intractable time deadlines. This paper sets forth a method of

approach that has proven useful in determining the reliability requirements of systems that operate under such hazardous conditions.

15. "On Prediction of System Performance from Information on Component Performance", J. R. Rosenblatt, National Bureau of Standards — This paper proposes some building blocks for an approach to useful representations of system performance or reliability as a function of pertinent aspects of component performance. Particular attention is given to the use of information on ways in which components are believed or known to be interdependent. Some simple hypothetical examples are given of mathematical expressions for the relation of system behavior to the behavior of interdependent components. Consideration is given to estimation and prediction of system reliability using data on components, and to use of the mathematical expression to simulate the effect of variations of component behavior on system performance.

16. "Evaluation of Failure Data", H. I. Zagor, American Bosch Arma Corp. — The evaluation of failure data can be made if graphs of failures vs. operating time are plotted and the data tested for adherence to (1) Poisson, and (2) negative binomial distributions. Methods of cumulative probability can be employed to select items. An example will be given of an analysis of amplifier failures in requiring immediate reliability attention. An example will be given of an analysis of amplifier failures in a computing laboratory. The calculations and formulas derived will be shown, and their application to electronic equipments to (1) analyze high unreliability items, (2) estimate spares, (3) compare competitive equipments, and (4) set up logistics procedures will be discussed.

Wednesday Luncheon

17. "Computers with European Accents", Arthur L. Samuel, IBM

Wednesday Afternoon
SESSION V: COMPONENT RELIABILITY

Ronald Cone, North American Aviation, Inc., Chairman

18. "Accuracy Control Systems for Magnetic-Core Memories", A. Katz, A. G. Jones, G. Rezek, RCA — Because of its simplicity and reliability, the coincident-current magnetic-core memory has become the standard storage medium in high-speed digital computers. The present paper is concerned with means for the immediate detection and speedy location of faults in the memory system. Two such means are described: one, for the register selection channels; the other, for the information channels. In association with appropriate alarm logic in the control element of the computer, these means complement each other in enhancing overall system reliability.

19. "Design of Basic Computer Building Block", J. Alman, P. Phipps, D. Wilson, Remington Rand Univac — This paper describes a system of circuit design which uses a high speed digital computer to do most of the design work. The digital computer will optimize the circuit by commutating component specifications and checking the circuit output requirements; therefore, allowing the circuit designer to choose a circuit that will operate with the widest tolerance on individual components. After this circuit is chosen the digital computer is again called upon to check this optimum circuit. The computer does this by calculating the variations in components that will make the circuit fail to perform.

20. "Error Detection in Redundant Systems", S. Schneider and D. H. Wagner, Burroughs Corp. — The paper is addressed generally to the problem of automatic detection of error of switching to a redundant standby. Comparator methods to pass a majority signal from a triplicated system are presented and evaluated. Some techniques are discussed for low-level duplication and low-level preventive maintenance--these are less promising because of the difficulty of automatic error-deteotion.

SESSION VI: ANALOG COMPUTER EQUIPMENT

Hans Meissenger, Hughes Aircraft Co., Chairman

21. "Analog Logarithmic and Antilogarithmic Circuits Using Switch Transistors", A. J. Schiewe and K. Chen, Westinghouse Elect. Corp. — Analog logarithmic and antilogarithmic circuits are described which take advantage of the inherent reliability of junction transistors and their stability when operated in the switching mode. The operation of the circuits is based upon the use of exponential time decays in conjunction with pulse-width modulation.

Circuitry is described for performing algebraic operations on the P. W. M. Signals (add., subt., mult., and div. by a constant). This algebraic circuitry uses a magnetic core of constant volt-time area. Test results in using the log-algebraic-antilog computer ensemble as a multiplier and as a square-rooter are given.

22. "High Precision Digital-to-Analog Conversion by Integration of a Variable Rate Pulse Train", A. D. Glick, Minneapolis-Honeywell Regulator Co. — A method of converting from straight binary to an analog voltage or.

shaft position is described. The analog output is produced by integrating a train of standard pulses whose effective rate is dependent on the binary input. The system, designed for an airborne digital computer, provides a continuous analog output for each binary input and responds in less than one microsecond to a change in the input. The results of tests performed on the system indicate a conversion precision of one part in ten thousand.

23. "A Reliable Method of Drift Stabilization and Error Detection in Large-Scale Analog Computers", E. E. Eddy, Goodyear Aircraft Corp. — This method of drift stabilization and error detection makes use of a multi-channel mechanical commutator and single stabilizer amplifier to stabilize many d.c. amplifiers. Past experience has shown the following to have major influence on system reliability: switch leakage, switch phasing, mechanical failure, capacitive couplings and hum pickup. Improvements in the commutator and the use of new and novel circuitry have greatly increased the reliability of this system. This provides a convenient central point for the detection of faulty operation of the computer. An alarm system using three separate fault indicators pin-points defective units.

24. "A New Method of Verifying analog Computer Problems and Performance", W. C. Meilander, Goodyear Aircraft Corp. — Electronic differential analyzers have become extremely useful tools in research and development work during the past decade. A factor limiting the extended utilization of analog computers has been the question of reliability, not only of computer performance, but of operator performance as well. This paper describes methods of verifying that an analog computer problem has been properly wired, that proper scale factors have been chosen, that "in use" computer components are functioning properly and that undesired patching has not been made. Other desirable features in computer reliability are discussed.

Thursday Morning
SESSION VII: NEW SYSTEMS B
Montgomery Pfister, Ramo-Wooldridge Corp., Chairman

25. "The Lincoln TX-2 Computer Development", W. A. Clark, Lincoln Laboratory, MIT — The Lincoln TX-2 incorporates several new developments in high-speed transistor circuits, large capacity magnetic-core memories, and flexibility in machine organization and is designed to work efficiently with many input-output devices of different types. Lincoln has constructed a small self-checking multiplier system which is on life test, and a complete, though skeletal, general-purpose computer known as the TX-0 which is now in operation.

26. "Functional Description of the Lincoln TX-2 Computer", J. M. Frankovitch and H. P. Peterson, Lincoln Laboratory, MIT — The Lincoln TX-2 computer is a general-purpose parallel binary machine with a code of 64 single-address instructions and 64 index registers. It includes a random access memory of 70,000 36-bit words with a speed of 160,000 36-bit additions per second. A unique feature of the central computer is its ability to deal with operands in one 36-bit, one 27 and one 9-bit, two 18-bit, or in four 9-bit configurations.

27. "The Lincoln TX-2 Input-Output System", J. W. Forgie, Lincoln Laboratory, MIT — The design utilizes the multiple-sequence program technique to permit the concurrent operation of a number of input-output devices. A stored program (instruction) counter is associated with each input-output device. A priority system ranks the devices according to speed and type of efficient operation. The multiple-sequence program technique provides an environment in which buffer storage may be reduced.

28. "Memory Units of the Lincoln TX-2", R. L. Best, Lincoln Laboratory, MIT — Two of these core memories are used for conventional storage of data and instructions. The third is used as a file of index registers and program counters. The largest memory contains 65,536 words 37 digits long. The next largest is entirely transistor driven and contains 4,096 words 37 digits long. The smallest and fastest contains 64 words 19 digits long and uses external selection and two cores per bit to achieve a "read" cycle time of 1 usec and a "write" cycle time of 3 usec.

29. "Standardized Circuitry for the Lincoln TX-2", K. H. Olsen, Lincoln Laboratory, MIT — Only two basic transistor logic circuits are used in TX-2, surface barrier transistors in saturated emitter-followers and saturated inverters.

Circuit tolerance to variations in transistor and other component characteristics, in temperature, supply voltages, and noise was studied. The study led to the selection of voltage sensitive parameters for indicating the deterioration of components with age and became the basis of the marginal checking system.

SESSION VIII: PROGRAMMING FOR RELIABILITY
Gene Amdahl, Aeronutronic Systems, Inc., Chairman

30. "Diagnostic Techniques Improve Reliability", M. Grems, R. K. Smith, W. Stadler, Boeing Airplane Co. — Diagnostic techniques are aids to testing, sampling and spot-checking a computer program. Reliability is an accumulation of confidence, assurance, and trustworthiness promoted by these techniques. Three levels of routines employing these techniques are discussed. Examples are given of routines which detect errors and stop the machine, which detect errors and record pertinent data before stopping, and which detect errors, record data, take corrective measures and then continue. Advanced diagnostic techniques not only improve reliability but are essential to computing systems.

31. "Error Detection and Error Correction in Real Time Digital Computers", A. Ralston, Bell Telephone Laboratories — A number of programming techniques are presented for the detection and correction of random transient computer errors in a digital computer operating in a real time environment. The term correction is meant to signify obtaining either the true value of the quantity in error or a sufficiently good approximation to enable the real time system to continue operation. Computer errors are classified according to the seriousness of the error to the system operation and the techniques presented are related to this classification of errors. The techniques include application of well-known mathematical methods as well as the use of newer, more specialized methods.

32. "The FORTRAN Automatic Coding System, Description and Users' Reports", J. W. Backus, et al, IBM — The FORTRAN Automatic Coding System enables the programmer to communicate with the IBM 704 using a language considerably more familiar and concise than the language of machine instructions. A program of about 22,000 instructions enables the 704 to accept a FORTRAN-language program and produce from it a 704-language program, ready to run.

The FORTRAN language is intended to be capable of conveniently expressing most procedures of numerical computation. Much of the translation procedure is devoted to producing a machine-language program which will run at about the same speed as one written by a good programmer.

Following a description of the FORTRAN System, members of several computing installations will describe their experiences in using it.

SESSION IX: SYSTEMS RELIABILITY
J. Howard Parsons, Hughes Aircraft Co., Chairman

33. "The Interpretation and Attainment of Reliability in Industrial Data Systems", B. K. Smith, Beckman Instruments, Inc. — No component is unreliable except as made so the way it is used. The practicality of proper use should determine the choice of component, rather than life statistics taken in any arbitrary environment. Fortunately, many of the ways to reliability also result in design and production economies. The inclusion of a digital computer as a part of an industrial control system can be a complication useful to the guarantee of continuous system operation. The built-in intelligence may be used to race system inertia, and through rapid repair make the difference between momentary failure and complete breakdown.

34. "Accuracy Control in the RCA Bizmac System", I. Cohen, J. G. Smith, A. M. Spielberg*, RCA, (*Formerly with RCA, now with General Electric) — The RCA Bizmac System has developed a philosophy designed to insure the maintenance of accuracy and reliability in its overall data processing functions. In its system design emphasis is placed on the accuracy requirements of all machines acting as parts of an integrated data processing system as well as upon the individual machine requirements. Adequate checks are provided in all machines of the system to maintain reliable operation, and a further set of checks is provided for the system as a whole to maintain reliability in data transfer. The basic design of the system controls was engineered to incorporate such checks.

35. "Continuous Computer Operational Reliability", R. D. Briskman, Army Security Agency — The paper is a study of system requirements to approach maximum reliability in the operation of the computer which must function continuously. Various type complexes, composed of multiple computers, are discussed in relation to system down time, allowable output error level, computer costs, continuity in data output, and probability of failure.

36. "Field Performance of a New Automatic Fault Locating Means", J. F. Scully, Monroe Calculating Machine Co. and L. P. Colangelo, Rome Air Development Center — The shortage of adequately trained personnel in the Air Force has not only hampered research and development programs, but has adversely affected sound field maintenance and the reliability of electronic equipment under operational

(cont'd on page 35)

ASSOCIATION FOR COMPUTING MACHINERY, LOS ANGELES CHAPTER

MEETING, LOS ANGELES, MARCH 1, 1957

"NEW COMPUTERS: A REPORT FROM THE MANUFACTURERS"

Immediately following the Western Joint Computer Conference in Los Angeles, February 26 to 28, the Los Angeles Chapter of the Association for Computing Machinery held a Symposium, "New Computers: A Report from the Manufacturers".

Following is the substance of the program, which did not contain abstracts.

In the past technical papers representing computer systems have been presented at technical meetings such as the Joint Computer Conferences and meetings of the Association for Computing Machinery. The question often arose: "Is a paper given by a computer manufacturer describing a new computer system a true and proper technical research paper for such a conference?" Two thoughts seem to run in opposition: first, the description of a new computer system by a manufacturer is often an advertising venture and not proper for a technical meeting; and, second, public presentations of detailed technical aspects of new computer systems are an important means of communicating information necessary and important to the user.

It seems clear, however, that it is entirely proper for, if not the responsibility of, the professional computer societies to provide a forum for the manufacturers to present and discuss new computers; the stated purpose of these groups is to exchange and disseminate technical information in the computer field. In recognition of this and the increased needs for information exchange in this rapidly developing field, the Los Angeles Chapter of the Association for Computing Machinery is sponsoring this Symposium.

The Symposium is one of the first intended solely for the presentation and discussion of technical details of new computer systems. Because the field has grown so large, the program has been restricted to papers describing general-purpose, large-scale systems for scientific and business applications. Furthermore, it was felt that the Symposium would serve the best interests of users and potential users everywhere if only the newest, most advanced, and most recently publicized computers were discussed.

Friday, March 1, 1957

Opening Remarks, Walter F. Bauer, The Ramo-Wooldridge Corp.; Chairman, Los Angeles Chapter, Association for Computing Machinery

Session I
Paul Armer, The RAND Corp., Chairman

"Magnetic Tape File Processing with the NCR-304, a New Business Computer", J. S. Sumner, National Cash Register, Inc.

"The Cardatron and the Datafile in the DATATRON System", F. G. Withington and Dean H. Shaw, ElectroData Corp.

"A New Large-Scale Data Handling System --DATAmatic 1000", W. C. Carter, DATAmatic Corp.

"The RCA BIZMAC II--Characteristics and Applications", J. A. Brustman, H. M. Elliott and A. S. Kranzley, RCA

Session II
Jack A. Strong, North American Aviation, Inc., Chairman

"Advanced Techniques in Univac Scientific Computer Systems", A. A. Cohen, Remington Rand Univac

"Recent IBM Developments in High Speed Computation and Design Objectives for the Super Speed Stretch Computer", J. L. Greenstadt and S. W. Dunwell, International Business Machines Corp.

"The Philco S-2000 Transistorized Large-Scale Data Processing System", S. Y. Wong, Philco Corp.

"The Logistics Research Model 800 Computer", Neil Block, Logistics Research, Inc.

Closing Remarks, John W. Carr III, University of Michigan; President, Association for Computing Machinery

SYMPOSIUM ON SYSTEMS FOR INFORMATION RETRIEVAL, WESTERN RESERVE UNIVERSITY SCHOOL OF LIBRARY SCIENCE, CLEVELAND, OHIO, APRIL 15-17, 1957, PROGRAM

A Symposium on Systems for Information Retrieval is to be held Monday, April 15 to Wednesday, April 17, 1957, at Western Reserve University, Cleveland 15, Ohio.

The host organization is the School of Library Science and its Center for Documentation Research. The co-sponsors are The Council on Documentation Research, and 16 other organizations representing diverse interests ranging from the American Bar Foundation to the Special Libraries Association.

Following is the program. (The numbers have been supplied by the editor of "Computers and Automation".)

Monday, April 15

Fundamentals in Systems Design

1. A Semantic Approach: "Problems in Defining", Philip B. Gove, General Editor, G. & C. Merriam Company

2. "Classification, Cataloging, and Indexing Systems", Maurice F. Tauber, Melvil Dewey Professor of Library Service, School of Library Service, Columbia University

3. "Organizational Problems of Technical Abstracting in the Field of Applied Mechanics", Stephen Juhasz, Executive Editor, Applied Mechanics Reviews, Southwest Research Institute

4. An Operations Research Approach: "Report of a Study for the National Science Foundation", Russell L. Ackoff (Director), Joseph McCloskey, Operations Research Group, Case Institute of Technology

5. An Engineering Approach: "The Basis for a General Theory of Documentation", James W. Perry (Director), Center for Documentation and Communication Research, School of Library Science, Western Reserve University

Semi-Automatic Systems

6. Hand-sorted Punched Cards - Subject field, "Metallurgy" - Presented by Marjorie R. Hyslop, Managing Editor, Metal Progress; Betty Bryan, Associate Editor, Metals Review, American Society for Metals; Thomas H. Rees, Research Assistant, Center for Documentation and Communication Research, School of Library Science, Western Reserve University

7. Machine-sorted Notched Cards: "Experience in Setting Up and Using the Zatocoding System" - Subject field, "Aeronautical sciences" - Presented by Claude W. Brenner, Allied Research Associates, Inc.

8. Uniterm Cards - Subject field, "Water pollution" - Presented by Patricia Mines, Case Institute of Technology

9. The Peek-a-Boo System (Batten-Cordonnier) - Subject field, "Instrumentation" - Presented by W. A. Wildhack, Joshua Stern, Office of Basic Instrumentation, National Bureau of Standards

10. "The Role of Foundations in Documentation Research — The Program of the Council on Library Resources", Verner W. Clapp, President, Council on Library Resources

Tuesday, April 16

Coordinated Systems

11. Introduction: "Foreign vs. American Developments", Allen Kent, Associate Director; Robert E. Booth, Research Associate; Center for Documentation and Communication Research, School of Library Science, Western Reserve University

12. "Intercontinental Guided Missives", James D. Mack, Librarian, Lehigh University

13. A Corporation's International Network: "Tentative Proposal" - Subject field, "Petroleum" - Presented by George S. Crandall, Philip Q. Stumpf, Technical Information Group, Research and Development Laboratory, Socony Mobil Oil Company, Inc.

14. The F. B. I. Network - Subject field, "Operations of the Identification Division" - Presented by C. Lester Trotter, Assistant Director, Federal Bureau of Investigation

15. Library Networks - Subject field, "Any" - Presented by Herman H. Henkle, Librarian, John Crerar Library; Margaret E. Egan, School of Library Science, Western Reserve University

16. Communications: "Present and Future" -

Presented by R. C. Matlack, Special Systems Engineer, Bell Telephone Laboratories, Inc.

17. Data-Vision: "Video Communication by Telephone Line" - Presented by J. C. Langner, Electronics Engineer, Fitzgerald's Communications

Systems Using Accounting or Statistical Machines

18. Retrieval of Information Manually or by Machine - Subject field, "Armor and kinetic-energy armor-defeating ammunition" - Presented by John McCafferty, Chief, Technical Information Section, Watertown Arsenal

19. Control of Data on the Pharmacologic Properties of Chlorpromazine - Subject field, "Pharmacology" - Presented by Robert L. Hayne, Fred Turim, Science Information Department, Smith, Kline, & French Laboratories

20. Chemical Structures and Responses of Organisms to Applied Chemicals--Coordination - Subject field, "Biological activity and chemical substances" - Presented by George A. Livingston, Isaac D. Welt, Chemical-Biological Coordination Center, National Research Council

21. Indexing and Retrieval of Literature Using Machine-sorted Punched Cards - Subject field - "Fuel and lubricant additives" - Presented by Ben H. Weil, Manager, Information Services Division; Barbara Hildenbrand, Supervisor, Literature Searching Section, Information Services Division, Ethyl Corporation Research Laboratories

22. "The Patent Office Problem", Robert C. Watson, Commissioner of Patents

Wednesday, April 17

Systems Using Accounting and Statistical Machines

23. Machine Searching for Legal Research - Subject field, "Mechanics liens" - Presented by Frederick B. MacKinnon, John C. Leary, American Bar Foundation

24. Retrieval of Information from Technical Reports on the Development Problems of Various Plastic Products - Subject field, "Plastics" - Presented by Gilbert L. Peakes, Bakelite Company

25. Adaptation of the ASM-SLA Metallurgical Literature Codes for Use with Machine-sorted Punched Cards - Subject field, "Metallurgy" - Presented by Barbara H. Weil, E. A. Clapp, Electro Metallurgical Company

26. A Deep Index for Internal Technical Reports - Subject field, "Chemistry" - Presented by Fred R. Whaley, Linde Air Products Company

Systems Using Computers or Computer-Like Devices

27. Abstracting, Coding, and Searching the Metallurgical Literature for A.S.M. The WRU Searching Selector - Subject field, "Metallurgy" - Presented by Cedric Flagg, Research Associate, Allen Kent, Associate Director, Center for Documentation and Communication Research, School of Library Science, Western Reserve University

28. Machine Searching of Patent Files using the SEAC Computer (N.B.S.) - Subject field, "Steroid compounds" - Presented by Don D. Andrews, Director, Research and Development, U. S. Patent Office; R. A. Kirsch, Louis C. Ray, National Bureau of Standards

29. Documentation by the Filmorex Technique - Subject field, "Scientific information" - Presented by Jacques Samain, Chef de Service, Centre National de la Recherche Scientifique, Paris, France

30. A Minicard System for an Information Center - Subject field, "Any" - Presented by J. W. Kuipers, A. W. Tyler, W. L. Myers, Eastman Kodak Company

31. Panel Discussion: "Machine Literature Searching Potentials in a Variety of Subject Fields" - Moderator, Robert C. McMaster, Professor of Engineering, Ohio State University

- END -

————————————*

Forum

ON GLOSSARIES — AND MALAPROPISMS

Alston S. Householder
Mathematics Research Center, U.S. Army
Madison 6, Wisc.

A common symptom of advancing age is a growing impatience with the foibles, fancies, and failings of the younger generation, coupled with a release of the inhibitions that had earlier restrained possible hortatory impulses. Age and experience may not always bring wisdom to others, but it is axiomatic that they do to oneself!

Among my own favorite abominations, a disrespect or low regard shown the mother tongue ranks very high. In particular, we, the mathematicians and the processors of data and information, are presumably experts in the handling of symbols. What, for example, are flow-charts and coding sheets? Presumably each of us is meticulous in manipulating the special symbols of his trade. Why, then, should he be less so in handling those symbols that are the common property of the public at large, experts included, and especially those which relate more directly to his own particular domain? Yet examples of laxity are legion. One can argue, of course, that the English language, like the Chinese people throughout history, combats invaders by assimilating them. But while the analogy is possibly apt, it should be equally apt to remark that assimilation occurs only when other defenses have failed.

On the technical level, a rather recent assimilation is the term "algorithm", defined as "any peculiar method of computing". In just commemoration of the Arabian algebraist al-Khwarizmi, the term "algorism" was adopted into the language to denote the art of computation with Arabic numerals. But alas for the memory of the defunct algebraist, logarithms also have to do with computing and the terms have a certain superficial similarity. Hence the meaning was broadened and the word transformed, and algorisms survive now chiefly in the dictionary. Sic transit gloria mundi.

The bastard formation "eigenvalue" is rather too technical for most general dictionaries (I understand Veblen pounced upon an offender with "You mean proper Werte?"), but it is probably permanently entrenched. Latin-Greek and Greek-Latin hybrids are fairly common and seem somehow less objectionable since these "dead" languages, in barbaric times like these, tend to coalesce into a uniform nimbus. But however objectionable, "eigenvalue" seems to be here to stay.

Dictionaries do not yet recognize "parallelopiped", but they may be forced to, eventually. The fourth vowel plays a very incidental role in "parallelogram"; it provides a euphonic link for the essential elements "parallel" and "gram". Yet somehow this particular vowel assumes a prominence incommensurate with its function, and tends to displace the second "e" in "parallelepiped", as though the word were composed of the parts "parallel" and "piped". Actually the solid figure is a parallel-epi-ped, or, if you like, a parallel upon a pedestal. Bipeds exist, but pipeds do not (or not yet).

In these examples the assimilation is in varying degrees complete, and probably nothing can be done about it. In some others there seems to be a trend, but whether the process is reversible is yet to be seen.

Among data-processors, a misconstruction of "data" seems especially reprehensible but there is a singular trend toward treating it as singular. I have not yet seen an intrusion of "datas" but I am waiting, and, in fact, the correct singular "datum" seems to have gone out of existence. Manuals issued by a leading manufacturer (which shall here be nameless!) seem to be consistent in taking "data" to be singular. There are nouns which can designate either a class or the members of that class, hence which can be construed as singular or plural according to the intention of the speaker (or writer); and there are nouns which, though plural in form are singular in construction, but "data" is not (yet) among them. Will it become so?

Mathematicians and the processors of data should be able to count, at least, and we should

not be, even if we often are, corrupted by the colloquial "between you and me and the gatepost". "Between" refers specifically to two, and not to three or more. A can be between any two of B, C, and D, but it is among the three of them.

Not being a lawyer, I cannot argue with the lawyers about their beloved "and/or", but in either scientific or popular discourse it can be explained only as affectation or laziness. The disjunction expressed by "or" is not necessarily exclusive. Hence "x or y or both" is unobjectionable. It is, moreover, inexpensive in terms of time, space, and printer's ink, and even the "or both" is generally unnecessary except for special emphasis.

A fact is a fact and no argument, period. And yet repeatedly one hears phrases like "true facts", "correct facts", or assertions that people argue over whether some fact is so. If it is a fact, it cannot fail to be so. One can argue about theories, assertions, speculations, hypotheses, conjectures, but never about facts. One can argue over whether an assertion states a fact, or whether that which is asserted as a fact is indeed a fact. And one can adduce facts to support, negate, refute or confirm an argument. But about facts one cannot argue. And that's a fact.

Even scientists are sometimes subject to a linguistic confusion of cause and effect in succumbing to an epidemic aphasia in the use of "imply". Perhaps "infer" sounds more elegant, but whatever the reason the custom of using it in the sense of "imply" seems to be mounting in scientific as well as in popular discourse. It is true that dictionaries recognize this as a possible meaning of "infer", but the habit is still reprehensible since it creates a potential source of confusion. Fowler, the English lexicographer, was especially emphatic about the importance of segregating meanings, not permitting a word having a particular, definite, function, to encroach upon another whose function is distinct. Clearly "infer" and "imply" are such words.

There is a story that a certain psychologist would not speak to his daughter for a week because three times in her thesis she used "different than". If he were alive today and behaved uniformly, he might condemn himself to much silence. According to Webster, x may be greater than y or less than y, and in either event it is other than y, and, in fact, different from y. Under "different" it is stated that whereas the word is normally followed by "from", there are good literary precedents for following it by either "to" or "than". But none is cited and the use is said to be considered improper by many. The fact of the matter is, one does not often see the bald, unadorned statement "x is different than y". Rather, "than" is generally introduced in an ineffectual attempt to escape from a grammatical trap, as in "a different x than y". The tendency to fall into this trap is understandable. English, unlike French, commonly places the modifier before the word modified. Hence one starts with "a different x" and then realizes that the modifier is incomplete. One might like to say "a different-from-y x", but everyone sees this would be going too far. The reasonable escape is, as usual, very simple. One has merely to start over and say "an x that is different from y", or even "an x different from y". In colloquial speech, of course, one cannot erase and may not wish to start over, but in writing there is no excuse.

There are a number of pitfalls for the non-native in expressions of degree, and often the natives succumb, whether through imitation or mere carelessness. We seem on the way to adopting "less or equal to", or "equal or less than", or both, and I can see no real argument against either, except that it offends the purist's (at least this purist's) ear, like the omission of a bar from a well known tune. There are difficulties in the use of words like "enough", "sufficient", "adequate". In these days of inflation, linguistic as well as monetary, one sees at times an amusing misuse of "excellence" as though it could be used as a criterion. In fact, the word means "surpassing requirement or expectation", and hence stands for a judgment one can make only in retrospect. One can hardly make an advance requirement that one's requirements be exceeded.

At a more technical level, though, and still on the subject of relations, I have seen many people who should know better apply the term "equation" where they should have used "expression". And even more often "roots" is used where zeros are meant. The distinction may seem pedantic, but functions and polynomials possess zeros; only equations possess roots.

To return briefly to grammatical traps, a possibly harmless but rather amusing and common one starts out with "What it is, is . . ." After arriving at the first "is" one recognizes the need for the second, yet feels uncomfortable about the repetition, and one escape is to disregard grammar and drop it. The logical solution is again to start over with a simple "it" in place of "what it is".

(Cont'd on next page)

(Cont'd from page 34)

Or if one feels that more of an introduction is needed, it would be: "Well, I'll tell you what it is. It's ..."

A true redundancy cannot be condemned on either logical grounds, or grammatical. Hence everyone has a right to his redundancy, and sometimes it can be effective, as for emphasis. But a particular redundancy, often repeated, comes to lose its force. An example of such is "each and every". I have no idea who started the fad, but in my mind it is strongly associated with inspirational talks heard during my youth in YMCA's and Sunday Schools. In technical discourse today it has nothing to contribute.

But "each" and "every" suggest "all", and also a little suggestion I heard made by a former professor. The suggestion is that it is generally easier to speak in the singular than in the plural. If a property P is possessed by all members of a class C, then it is possessed by each (and every!) member of C. Many times I have started to say something about all members of a class, and become hopelessly lost in a grammatical maze. But by starting over and making the assertion about each (<u>or</u> every) member the difficulties melted away.

I have, in my own published writings, perpetrated and propagated many barbarities for which I blush today. In a rapidly changing technical field the language is correspondingly fluid, and all of us who publish on the subject are helping to create and establish the technical vocabulary of the field. We have therefore a particular responsibility to select our technical vocabulary well. Among the words I have helped perpetuate and now regret, are "round-off" and "approximation" used as adjectives. The correct adjectives are, of course, "rounding" in the one case, "approximate" or "approximating" in the other. It is part of the strength of our language that it is possible to use a noun as a modifier when needed, although there are times when one could wish for a special ending to be attached as a signal. But in any event, to use a noun as an adjective where a perfectly good adjective exists is surely gratuitous.

And so my homily concludes with a brief confession. I seem to be fallible, too.

- END-

(cont'd from page 29)

conditions. A special purpose computer, built for the Rome Air Development Center by the Monroe Calculating Machine Company, included a unique automatic internal diagnosis unit which quickly pinpoints any malfunction in one of the computers 4,500 logical elements. This paper will discuss the diagnosis techniques employed and will present the field performance results achieved in the pioneer application.

SESSION X: PROGRAMMING
Paul Armer, The RAND Corp., Chairman

37. "The Variable Word and Record Length Problem and the Combined Record Approach on Electronic Data Processing Systems", N. J. Dean, Ramo-Wooldridge Corp. -- This paper distinguishes between "fixed", "adjustable" and "variable" word and record lengths. It discusses some of the advantages of the variable word and record lengths and the "expandable" record in practical business data-processing applications. A technique for reducing the variability of storage required for detailed transactions is presented. A typical application (commercial deposit accounting) is described in which a drastic reduction in storage requirement is affected by utilizing statistical averaging.

38. "Empirical Exploration of the Logic Theory Machine", A. Newell, J. C. Shaw, H. A. Simon, The RAND Corp. -- The Logic Theory Machine is a program that discovers proofs for theorems in elementary symbolic logic. It does this, not by means of an algorithm (although such algorithms exist), but by using heuristic devices, much as a human does. This paper presents the results of detailed explorations of the program on RAND'S JOHNNIAC (see following paper). It describes the program and evaluates the contribution of the various methods and heuristics to the total problem solving capability of the machine.

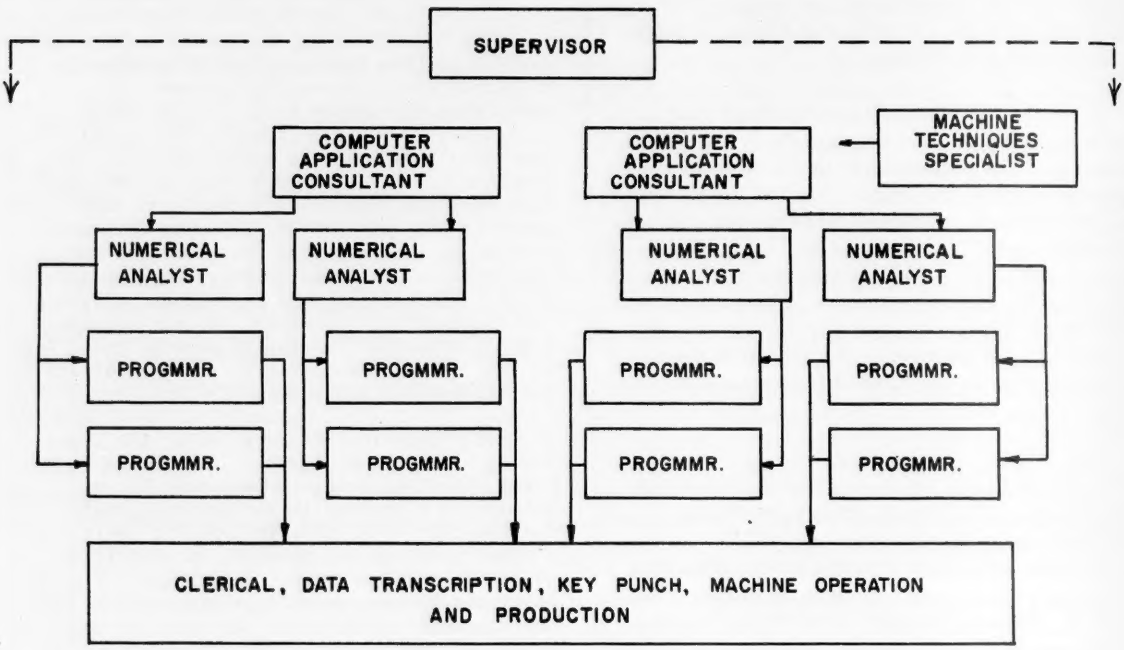
39. "Programming the Logic Theory Machine", A. Newell and J. C. Shaw, The RAND Corp. -- The Logic Theory Machine (called LT, see previous paper) represents a class of non-numerical problems with quite different programming requirements than either normal arithmetic calculation or business data processing. The program itself is a large, complicated hierarchy of subroutines. For LT an intermediate language (interpretive psuedo code) was written for the RAND JOHNNIAC. This language is independent of symbolic logic, the subject matter of LT, and is a general language for information processing. This paper first characterizes the programming problems involved, and then illustrates solutions to them by describing the language.

- END -

DIVISION OF LABOR
(cont'd from page 7)

The details of the work beyond the programmer will not be discussed in this article. The people required to handle these details are included in the bottom block of the accompanying diagram. Some of these details are: data transition from problem to form acceptable for machine input, card punching, routine running of the problem on the machine for various data input sets, and the clerical work involved in any operation.

What has been described (as diagrammed in the accompanying chart) should complete the requirements for a complete computer installation. The number of people will depend on the size of the installation. If it is so desired, a unit of the type shown on the diagram may specialize in a particular application, such as aircraft; then the complete organization may be made up of a unit for each application in which the company is engaged.



ORGANIZATION CHART
for
COMPUTER SERVICE SECTION

COMPUTER USE
(cont'd from page 19)

and examined by a simple program which produces the following effect:

(a) Read in the next symbol.

(b,1) If it is an alphabetic character, and if the previous punctuation mark has been doubled, punch it out.

(b,2) If it is an alphabetic character, but the previous punctuation mark has not been doubled, return to (a).

(b,3) If it is a punctuation symbol examine the next character. If this is also a punctuation symbol store suitable instructions to produce (b,1) and (b,2). Punch out the symbol and return to (a). If the next character is not a punctuation symbol modify (b,1) and (b,2) appropriately and return to (a).

The final operation is to print out the contents of the tape just produced, again presented to the printing reader backwards. The output will be a list of the iso-structural units contained in the original text.

This type of program can be extended to give page and line indications, and also to enable simultaneous examinations to be made for several different structural units. Since, however, no new principles are involved, it is not worth detailing the program steps which are required.

BIBLIOGRAPHY

(1) "Nature", by A. D. Booth, 176, (1955) 565.
(2) "Automatic Digital Calculators", by A. D. Booth and K. H. V. Booth, p. 221, 2nd Ed. Butterworths, London (1956).

NEW PRODUCTS AND IDEAS
(cont'd from page 9)

he states his problem as an equation. Next, he draws up a flow chart analysis of the problem as a series of computer operations. Then he fills out a coding sheet from which the computer's key punch operators take instructions.

Finally, he prepares a test case to which he knows the answer. When his problem runs on the machine, he checks the answer, and eliminates troubles through diagnostic methods taught in the class.

The Lockheed do-it-yourself computing opportunity is the result of a new simplified coding technique called SOAP (for Symbolic Optimum Assembly Programming) developed by International Business Machines Corp. Using this technique, the employee can write the actual equations on his coding sheet instead of a more complicated system of address numbers normally used to locate various pieces of information within the machine. The new opportunity is designed for employees who have never seen or used a computer before. It can be used to solve both scientific and accounting problems.

SUPPLEMENTING
(cont'd from page 17)

Still another impediment must be overcome if electronosensory systems are to be effectively implemented. This is the leverage applied against them via Government in the communications industry. Federal Communications Commission approval must be obtained to use micro-wave transmitters even locally. The concept of visual data transmission is quite new to that agency and time is needed to work out the rules, as well as to get judicial precedent for private operation of any kind of television micro-waving. One regional director has reportedly expressed interest in the possibilities, indicating that trials might be permitted in wavebands allocated to experimental use, but temporarily only. Lawsuits are pending in one instance to resolve the issue between a communications company and a semi-private authority, although data transmission as such is not a part of the contemplated television micro-waving. There should be no hesitation to press the issue. The economic significance of the control function is at least equal to use of space radio for railroad yards and taxicabs. Industry should make a consolidated bid for bands reserved to this purpose. Incidentally, some pipelines do micro-wave radio data to pumping control points many miles from the point of transmission.

There are other obstacles, also, which require surmounting. Many plants do not have a reliably cycled source of electrical current. For television cameras, this is a must. Job standards for monitor personnel will have to be developed. It is also true that the idea of inquiry units to central needs expansion. Clearly, industrial accountants would do well to procure some technical knowledge of communications!

Re-Birth of Control

A new electronosensory component of organization to extend the eyes and ears of management, more reliable and speedier than anything so far proposed or in use, promises return of a degree of contact and control which management has not had for years. Magnetic storage and electronic computation, the heart of the concept, is instantaneous but worthlessly so unless input is equated to its capacity. A drastic cut in paperwork is not only the objective of the system, but the major principle enabling such a system to develop effectively. Also the cost of such a system is potentially low enough to merit use by many small companies.

A communication system, having the necessary characteristics to meet the above specifications, demands decentralization of data origination, and may be the key to decentralized data processing. However, the centralized potential of the processing equipment is so far from full development that a course of centralization may be desirable for a number of years yet. "Micro-linking" of data storage units would enable decentralization eventually, however.

The industrial accountant needs a medium other than paperwork to provide managerial control of an eight hundred billion dollar economy by 1975. Fortunately, it is available and, in the bargain, many production people can be freed from clerical duties. The consolidation of visual, auditory, and instantaneous input and output, with a storage and processing capacity of proportions commensurate with the business, can return management to the enviable position of the sole proprietor—action based on observation, quickly reduced data, and relegation of detail. But the structure is fundamentally human rather than mechanical. It pre-supposes the control communications specialist who can be justified by his command over a large volume of data, and who will remove the undue emphasis of mechanics inherent in paper tapes or cards.

Direct use of the magnetic storage medium will provide a renaissance of control in the twentieth century, if the industrial accountant and his systems people provide it with good communications. It will be helpful to remember we are in the communications business on a big scale, whether or not we ever thought of it before. Will we adapt our communications tools to a renaissance of control?

- END -

* * *

HISTORY
(cont'd from page 24)

chives of Neurology and Psychiatry, Vol. 67, Feb. 1952

231. Schiller, F.; Consciousness Reconsidered, Archives of Neurology and Psychiatry, Vol. 67, Feb. 1952

232. Brazier, Mary A. B.; Expanding Concepts in Neurophysiology, Archives of Neurology and Psychiatry, Vol. 67, April, 1952

233. Gerard, R. W.; The Biological Roots of Psychiatry, Amer. Jr. of Psychiatry, Vol. 112, No. 2, Aug. 1955

- END -

Are you Looking for

REFERENCE INFORMATION

in the Computer Field?

COMPUTERS AND AUTOMATION

publishes 16 kinds of reference information that computer people can hardly afford to be without. Latest issues containing each are indicated.

Organizations:
- Roster of Organizations in the Computer Field (June, Aug. 1956)
- Roster of Computing Services (June 1956)
- Roster of Consulting Services (June 1956)

Computing Machinery and Automation:
- Types of Automatic Computing Machinery (March 1957)
- Roster of Automatic Computers (June 1956)
- Outstanding Examples of Automation (July 1954
- Commercial Automatic Computers (Dec. 1956)
- Types of Components of Automatic Computing Machinery (March 1957)

Products and Services in the Computer Field:
- Products and Services for Sale or Rent (June 1956)
- Classes of Products and Services (March 1957)

Words and Terms: Glossary of Terms and Expressions in the Computer Field (Oct. 1956)

Information and Publications:
- Books and Other Publications (many issues)
- New Patents (nearly every issue)
- Roster of Magazines (Dec. 1955)
- Titles and Abstracts of Papers Given at Meetings (many issues)

People: Who's Who in the Computer Field
- Cumulative (1957, Extra No. E1)
- Supplements (various issues)

BACK COPY PRICE: If available, $1.25 each, except: June 1955, $4.00, and June 1956, $6.00 (the June issue is the Computer Directory issue); 1957, No. E1, Who's Who in the Computer Field, $17.50.

- - - - Mail this coupon (or a copy of it) - - - -

To: Berkeley Enterprises, Inc.
815 Washington St., R198
Newtonville 60, Mass.

Please send me the following back copies:

I enclose $__________ in full payment. If not satisfactory, returnable within week for full refund (if in good condition).

My name and address are attached.

GLOSSARY OF TERMS

in the field of COMPUTERS AND AUTOMATION

- Over 480 terms defined
- Careful definitions; most of them expressed in plain words understandable to persons who have newly come into the computer field
- Many examples of meaning
- 4th cumulative edition, as of Sept. 19, 1956
- Reprinted from the October 1956 issue of "Computers and Automation"
- If not satisfactory, returnable within week for full refund (if in good condition)

$1.00 postpaid; 10% discount on orders for 20 or more copies.

----Mail this coupon (or a copy of it)----

To: Berkeley Enterprises, Inc.
815 Washington St., R 198
Newtonville 60, Mass.

Please send me __________ copy (ies) of the GLOSSARY, 4th edition. I enclose

$__________ in full payment.

Returnable if not satisfactory.

Name__________________________

Address__________________________

ARE YOU LOOKING FOR

COMPUTER PEOPLE?

— mathematicians, engineers, programmers, systems analysts, supervisors, and other trained people in the computer field? If so —

• We can help you in three ways:

1 — Who's Who in the Computer Field 1956-57: This extra number of "Computers and Automation" is now published. It contains 199 pages of entries with about 61 entries per page, or over 12,000 entries, showing names, addresses, and some information. —— Sample full entry (interpreted): Carr, John W, III / Asst Prof Math, Univ of Michigan, Ann Arbor, Mich / ADLMP (i.e., main interests: Applications, Design, Logic, Mathematics, Programming) / (born:) '23, (last college:) Mass Inst of Techn, (entered computer field:) '48, (occupation:) mathematician / (distinctions:) pres Assocn for Computing Machinery 1956-8. —— Sample brief entry: Sutherland, Ivan / 152 Bradley Road, Scarsdale, N Y.

• Following is an order form

2 — Advertising in "Computers and Automation". Many important companies use our pages for their ads to enlist computer people for their organizations. Our advertisers of employment opportunities include General Electric, International Business Machines, Lockheed, North American Aviation, Ramo-Wooldridge, Remington Rand, and many more. We have over 2500 subscribers and an additional (estimated) 5000 readers. Quarter page rate, $55; full page, $190.

• Our rate card and details will be sent to you for the asking

3 — Mailings to Computer People. We have on metal address plates over 10,000 names of computer people (entrants in the Who's Who, members of computer societies, expiries to "Computers and Automation", registrations at computer meetings, etc.). They are subdivided geographically. Their number is increasing daily. Cost, $19 a thousand envelopes addressed (less for participants in the list, and for non profit organizations). (Note: Send us your proposed mailing piece first for approval, then send the envelopes for addressing NOT TO us in Massachusetts BUT TO Publishers Mailing Service, 38 First St., New York 3, N. Y., where the plates are located.)

• Following is an order form

I hope we can be of help to you —

Edmund C. Berkeley

Edmund C. Berkeley
Editor, Computers and Automation

From:
COMPUTERS AND AUTOMATION
Berkeley Enterprises, Inc.
815 Washington St.
Newtonville 60, Mass.

------ MAIL THIS REQUEST or a copy of it ------

To: COMPUTERS AND AUTOMATION
815 Washington St., R198
Newtonville 60, Mass.

1. ( ) Please send us ________ copy(ies) of "Who's Who in the Computer Field 1956-57", at $17.50. Returnable within one week, if not satisfactory, for full refund. We enclose $________________.

2. ( ) Yes, we may be interested in advertising in "Computers and Automation". Please send us rate card and more information.

3. ( ) We are interesting in using your address plates for mailings to computer people. Here is our proposed mailing piece for your approval.

Name________________________ Title__________

Organization_____________________________

Address_________________________________

____

ADVERTISING IN "COMPUTERS AND AUTOMATION"

Memorandum from Berkeley Enterprises, Inc.
Publisher of COMPUTERS AND AUTOMATION
815 Washington St., Newtonville 60, Mass.

1. What is "COMPUTERS AND AUTOMATION"? It is a monthly magazine containing articles, papers, and reference information related to computing machinery, robots, automatic control, cybernetics, automation, etc. One important piece of reference information published is the "Roster of Organizations in the Field of Computers and Automation". The basic subscription rate is $5.50 a year in the United States. Single copies are $1.25, except the June issue, "The Computer Directory", (1956, $6.00; 1955, $4.00). For the titles of articles and papers in recent issues of the magazine, see the "Back Copies" page in this issue.

2. What is the circulation? The circulation includes 2650 subscribers (as of Feb. 15); over 300 purchasers of individual back copies, and an estimated 4000 nonsubscribing readers. The logical readers of COMPUTERS AND AUTOMATION are people concerned with the field of computers and automation. These include a great number of people who will make recommendations to their organizations about purchasing computing machinery, similar machinery, and components, and whose decisions may involve very substantial figures. The print order for the February issue was 3000 copies. The overrun is largely held for eventual sale as back copies, and in the case of several issues the overrun has been exhausted through such sale.

3. What type of advertising does COMPUTERS AND AUTOMATION take? The purpose of the magazine is to be factual and to the point. For this purpose the kind of advertising wanted is the kind that answers questions factually. We recommend for the audience that we reach, that advertising be factual, useful, interesting, understandable, and new from issue to issue. We reserve the right not to accept advertising that does not meet our standards.

4. What are the specifications and cost of advertising? COMPUTERS AND AUTOMATION is published on pages 8 1/2" x 11" (ad size, 7" x 10") and produced by photooffset, except that printed sheet advertising may be inserted and bound in with the magazine in most cases. The closing date for any issue is approximately the 10th of the month preceding. If possible, the company advertising should produce final copy. For photooffset, the copy should be exactly as desired, actual size, and assembled, and may include typing, writing, line drawing, printing, screened half tones, and any other copy that may be put under the photooffset camera without further preparation. Unscreened photographic prints and any other copy requiring additional preparation for photooffset should be furnished separately; it will be prepared, finished, and charged to the advertiser at small additional costs. PLEASE DO NOT SEND US METAL PLATES OR ELECTROS; please send reproduction proofs instead. In the case of printed inserts, a sufficient quantity for the issue should be shipped to our printer, address on request.

Display advertising is sold in units of a full page (ad size 7" x 10", basic rate, $190), two-thirds page (basic rate, $145), half page (basic rate, $97), and quarter page (basic rate, $55); back cover, $370; inside front or back cover, $230. Extra for color red (full pages only and only in certain positions), 35%. Two-page printed insert (one sheet), $320; four-page printed insert (two sheets), $590. Classified advertising is sold by the word (60 cents a word) with a minimum of 20 words.

5. Who are our advertisers? Our advertisers in recent issues have included the following companies, among others:

AMP, Inc.
American Bosch Corp.
Ampex Corp.
Armour Research Found.
Arnold Engineering Co.
Automatic Electric Co.
Bendix Aviation Corp.
Bryant Chucking Grinder Co.
Cambridge Thermionic
Epsco, Inc.
Ferranti Electric Co.
Ferroxcube Corp.
General Electric Co.
General Transistor Corp.
International Business Machines Corp.
Lockheed Aircraft Corp.
Lockheed Missile Systems
The Glenn L. Martin Co.
Monrobot Corp.
Norden-Ketay Corp.
Northrop Aircraft Inc.
George A. Philbrick Researches, Inc.
Potter Instrument Co.
Ramo-Wooldridge Corp.
R. C. A. Service Co.
Reeves Instrument Co.
Remington Rand, Inc.
Republic Aviation Corp.
Sprague Electric Co.
Sylvania Electric Products, Inc.

ADVERTISING INDEX

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose, the kind of advertising we desire to publish is the kind that answers questions such as: What are your products? What are your services? And for each product: What is it called? What does it do? How well does it work? What are its main specifications?

Following is the index and a summary of advertisements. Each item contains: Name and address of the advertiser / subject of the advertisement / page number where it appears / CA number in case of inquiry (see note below).

Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill. / Relays / Page 5 / CA No. 1

Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass. / Geniac and Tyniac Electric Brain Construction Kit / Page 41 / CA No. 2

Burndy Engineering Co., Inc., Norwalk, Conn. / Uni-Ring / Page 48 / CA No. 3

Cambridge Thermionic Corp., 430 Concord Ave., Cambridge 38, Mass. / Components / Page 47 / CA No. 4

Computers and Automation, 815 Washington St., Newtonville 60, Mass. / Back Copies, Reference Information, Glossary, Computer People, Advertising Rates and Specifications / Pages 37, 40, 40, 43, 44 / CA No. 5

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N.Y. / High Speed Tape Reader / Page 41 / CA No. 6

General Electric Co., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio / Employment Opportunities / Page 39 / CA No. 7

General Electric Co., Computer Dept., 1026 Van Ness, Tempe (Phoenix), Arizona / Employment Opportunities / Pages 2, 43 / CA No. 8

International Business Machines Corp., 590 Madison Ave., New York 22, N.Y. / Employment Opportunities / Page 45, CA No. 9

The Ramo-Wooldridge Corp., 5730 Arbor Vitae St., Los Angeles 45, Calif. / Employment Opportunities / Page 43 / CA No. 10

Schweber Electronics, 122 Herricks Rd., Mineola, L.I., N.Y. / G.E. Tantalytic Capacitors / Page 39 / CA No. 11

READER'S INQUIRY

If you wish more information about any products or services mentioned in one or more of these advertisements, you may circle the appropriate CA Nos. on the Reader's Inquiry Form below and send that form to us (we pay postage; see the instructions). We shall then forward your inquiries, and you will hear from the advertisers direct. If you do not wish to tear the magazine, just drop us a line on a postcard.

READER'S INQUIRY FORM

Paste label on envelope:↓

Enclose form in envelope:↓

BUSINESS REPLY LABEL
NO POSTAGE STAMP NECESSARY IF MAILED IN U.S.A.

FIRST CLASS
PERMIT NO 1680
Sec. 34.9, P. L. & R.
NEW YORK, N. Y.

4¢ Postage Will Be Paid By —

BERKELEY ENTERPRISES, INC.
38 East 1st Street
New York 3, N. Y.

READER'S INQUIRY FORM

Name (please print)..........

Your Address?..........

Your Organization?..........

Its Address?..........

Your Title?..........

Please send me additional information on the following subjects for which I have circled the CA number:

1	2	3	4	5	26	27	28	29	30	51	52	53	54	55	76	77	78	79	80	101	102	103	104	105	126	127	128	129	130
6	7	8	9	10	31	32	33	34	35	56	57	58	59	60	81	82	83	84	85	106	107	108	109	110	131	132	133	134	135
11	12	13	14	15	36	37	38	39	40	61	62	63	64	65	86	87	88	89	90	111	112	113	114	115	136	137	138	139	140
16	17	18	19	20	41	42	43	44	45	66	67	68	69	70	91	92	93	94	95	116	117	118	119	120	141	142	143	144	145
21	22	23	24	25	46	47	48	49	50	71	72	73	74	75	96	97	98	99	100	121	122	123	124	125	146	147	148	149	150

REMARKS:

UNI-RING offers a tremendous saving in installation time over any previous method of tapping or terminating shielded or coaxial cable. As the inner ring slides under the shielded braid, the tap wire is held between the braid and the outer ring. Single or multiple taps, from either the front or back of the connector, can be accommodated . . . A single crimp, using the same basic HYTOOLS used for installing HYRINGS, completes the uniform, secure, and insulated assembly.

The protecting nylon insulation extends beyond both ends of the UNI-RING, eliminating metal-to-metal contact and preventing harmful wire-chafing in tight locations. The UNI-RING is color-coded to indicate conductor sizes.

UNI-RING's one-piece design insures electrical integrity, prevents heating, and eliminates noises caused by isolated metal parts.

For samples and complete details, write: OMATON DIVISION

BURNDY

56-15

Norwalk, Connect. • Toronto, Canada • Other Factories: New York, Calif., Toronto • Export: Philips Export Co.

58-15

Co.